Oral History Program
University Library
University of California, Davis

THE ENGINEERING OF ABUNDANCE
an oral history memoir
of ROY BAINER

Preface by Bernard Kreissman
University Librarian
University of California, Davis

Introduction by Clarence F. Kelly
Director Emeritus
California Agricultural Experiment Station

Interviews conducted by A. I. Dickman
Head
Oral History Center
University of California, Davis

TO MY FATHER AND MOTHER, MY WIFE, LENA, AND MY DAUGHTER, LA NELLE

Most recent portrait of Roy Bainer

TABLE OF CONTENTS

ILLUSTRATIONS FOLLOW THESE PAGES:

INTRODUCTION

You are about to read the oral history of Roy Bainer--the life of an extraordinary man living in extraordinary times.

It has been my good fortune to have watched Roy Bainer from afar as he advanced through life. Every once in awhile he would look up, see me, and I was benefited or helped. There were many other people on his horizon--usually, as they say in the Navy, "astern of his beam," and he helped them also. His main attribute, the power that propelled him, was enthusiasm, of which he had more than his share. If one came in contact with Roy Bainer when he was developing one of his ideas and _he_ needed help, you would be converted willy nilly to that idea by his overwhelming enthusiasm. I have often wondered what he would have become if he had decided to be a politician or lawyer or salesman instead of a farmer, an engineer, a teacher.

I first heard of Roy Bainer (he is four years older than I am) when I was a young agricultural engineer in Washington, D.C. I was studying the drying of wheat in grain bins and measuring the rate at which various low air pressures would push air up through the damp grain. My pressures were low--"natural," from the wind--from .05 to 0.5 inches water gauge. (This project was conducted in the not yet completed new South Building of the U.S. Department of Agriculture and I recall I generated thousands of grain weevils which escaped and disgusted the secretaries in surrounding offices.) The question was not, however, what should be done with me because of the weevils, but were my measurements correct? They did not look reasonable to some of the more senior members of the staff. How can one be sure? "See if the upper end of your curves fit the lower end of someone else's curves taken at higher pressures," said the boss. So, to the library and the literature on farm grain drying and to the paper Roy Bainer had written on his California studies years before. Thankfully, the upper end of my curve fitted the lower end of his curve, the boss was convinced, and I was happy.

Later--eighteen years later--I came to California also, to study livestock environment--the effect of the weather, temperature, humidity, wind, upon the comfort and well being of farm animals. We wished to determine the temperatures involved and the heat flow between pigs and the floors they were lying on. Again we went to the library to see who had been before us. Roy Bainer! Roy's masters thesis at Kansas State had been on the floor temperature relations in the milking barn.

I cannot comment on all of Roy Bainer's oral history. Although he hired me in 1950 to work as an associate agricultural engineer in the California Agricultural Experiment Station, in the Department of Agricultural Engineering of which he was chairman, none of us could possibly be acquainted with all of his activities. But we all knew that Roy was around, was interested in what we were doing (sometimes more interested than some of us because the problems had been brought to him by California citizens before we heard about them) and certainly his enthusiasm about the progress and the meaning of the results was many times greater than ours.

Roy Bainer was a fine department chairman. He had no problem in maintaining contact with the California rancher and farmer, he knew most of the leaders in the farm equipment industry both in California and nation wide, he knew enough politicians to keep the rest of us aware of upcoming problems, and he took a very important part in the administration of the statewide university through his positions on several statewide committees. He never bluffed--when he called the dean or the president they knew he was not crying "wolf," and gave him immediate and respectful attention. He was a perfect tender of the taxpayer's dollar--no money was ever wasted in the Department of Agricultural Engineering under his leadership. The system he followed was simply to hire the best staff he could find and then help them in their research in every way possible. This included a free rein on funds. But the hitch was that Roy was able to make each staff member as conscious of the value of the taxpayer's dollar as he was himself. I recall vividly his graphs, at the monthly staff meetings, showing the state of the budget at that time, how we were coming compared to last year, who was responsible for the long distance telephone curve running off the chart six months ahead of time, why the student help budget was high, where some one was actually slowing down progress because he was not spending enough, and the dire consequences if we did not end the year in the black. But never did I hear him say to slow up our research because of a lack of funds: "Go ahead, I will see if I can find something!"

The reader should consider this oral history from two viewpoints as he advances through it. First, it is the life of a man who started out as an average American boy but who, through hard work and enthusiasm, developed into an extraordinary man, an engineer known over the entire world and awarded the highest honors by his fellow engineers, an educator who left his imprint on hundreds of young men and women, an advisor who helped thousands and thousands of people, from the United States

family farmer to the consumer of Asia and South America; second, it is the history of the three-quarters of a century during which world commercial agriculture converted from horse and mule power to fossil fuel power, during which it became possible for five percent of us to raise all of our country's food instead of fifty percent of us, during which the United States and especially California was converted from desert and brushland to cultivated fields. As you read, observe the effect Roy Bainer had upon these times, and the effect the times had upon Roy Bainer. Watch the unfolding of our country. It will be a pleasurable experience!

Clarence F. Kelly
Director Emeritus
California Agricultural
Experiment Station

PREFACE

One of the earliest and strongest impressions a newcomer to the Davis campus receives is the markedly strong sense of pride the University holds for its Aggie antecedents. While a great number of the country's universities make every effort to efface their origins as agricultural institutions, Davis emblazons the fact of its beginnings throughout its programs. It is not only a sign of campus self-confidence, after all we know we are the best, it is even more a mark of our respect for the women and men who created a vigorous and distinguished general university from an outstanding agricultural college.

In this history we have a synthesis of the reasons for that pride and respect; the remarkable capabilities and consequent influence of an unaffectedly natural man, and through him as guide, a chronicle of the growth and florescence of the Davis campus. A homely narrative is thus transmuted to a major social document.

Roy Bainer's career provides a clear exposition of the role of the individual in the life of an institution. He is an exemplar of the scores of men and women whose personal strengths were converted to the collective vitality of the University. The University of California at Davis stands on their shoulders and we are fortunate to have had modest giants like Roy Bainer amongst us in the beginning.

Bernard Kreissman
University Librarian

INTERVIEW HISTORY AND BRIEF RÉSUMÉ OF UC DAVIS ORAL HISTORY CENTER PROJECTS

The oral history memoir of Dean Emeritus Roy Bainer is the fourth in a series, supported by the Shields Library of UC Davis, of persons who have played a leading and historic role in both the history of the campus and in the development of agriculture in California.

The three memoirs which have been completed are: the late Professor Emeritus, Ben Madson, A Pioneer in Agricultural Education; interviewer, A. I. Dickman; Professor Emeritus Albert J. Winkler, Viticultural Research at UC Davis, 1921-1971; interviewers Ruth Teiser (Berkeley) and Joann Larkey; Chancellor Emeritus Emil Mrak, A Journey Through Three Epochs: Food Prophet, Creative Chancellor, Senior Statesman of Science, including a brief memoir of his wife, Dr. Vera Mrak; interviewer, A. I. Dickman.

These memoirs are in progress: the late Professor Emeritus Tracy L. Storer (1889-1974) From Observation to Experiment: Development of Zoology, UC Davis 1923-1956 including a memoir of his widow, Dr. Ruth Storer; interviewer, A. I. Dickman. Professor Emeritus Max Kleiber, Engines That Fuel Themselves: My Life as a Student of Bioenergetics; Arthur "Milt" Smith, Arthur L. Black and A. I. Dickman; Professor Emeritus James F. Wilson, Wool Scientist; interviewers Glenwood Spurlock and A. I. Dickman; several shorter memoirs on friends and members of the Power family (Nut Tree); interviewer, Joann Larkey. Other projects in process are: the School of Veterinary Medicine, UC Davis. This is a series of memoirs of persons who were among the original planners at Berkeley which resulted in the formation of the School and of those who have participated in a major way in its growth and development. The Processing Tomato Industry: This is a series of memoirs of persons who developed the tomato harvester system and the compatible processing tomato. It pictures the dramatic changing conditions in the words of faculty at UC Davis who did the scientific and engineering research, growers, canners, manufacturers, workers and others.

Roy Bainer was taped in twenty-eight sessions held almost daily, except for weekends, from February 15, 1972, to March 27, 1972. Except for the first session, all interviews were held in the J. R. Blanchard Rare Books Room, Special Collections, Shields Library, UC Davis. Each interview lasted approximately one and one-half hours. Bainer was called to Spain as a consultant to the Spanish government on the construction and organization of six agricultural research centers. He was in Spain in December, 1971, again in January and the first part of February, 1972, and he returned to Spain for a short ti in May, 1972. Upon his return to Davis in May the account of his Spanish experiences was recorded in one session of several hours.

The interviewer prepared for the interviews by talking to various friends and colleagues of Dean Bainer. He also had access to four thick scrapbooks containing newspaper clippings, personal letters and other memorabilia lovingly conserved by the daughter, La Nelle Bainer. In addition, the interviewer had looked over the publications listed in the Bainer bibliography and had consulted the records of the Department of Agricultural Engineering.

From these sources, an outline was prepared which is similar in topical headings to the table of contents used in the memoir. While the outline was generally followed, Dean Bainer was made aware of the fact that the transcriptions could be edited topically and he was encouraged to record episodes as he recalled them even though out of context.

Fewer questions than average were needed to produce the narrative flow from the interviewee. He was very willing to tell of his experiences and he was aware of the fact that his professional life spans the years during which the use of machinery in California agriculture increased at a phenomenal rate. (In the period after World War II ending in the early 1960s, Carroll and Dunbar of Purdue University estimate that the number of tractors tripled on U.S. farms, there were twice as many trucks, three times as many milking machines, four times as many combines and six times as many mechanical corn pickers in use as before the war. With this unprecedented use of farm machinery, farm production per worker doubled.)

A Time magazine article called Davis "the wildly inventive center of the farm machinery revolution." Bainer realized that he had a hand, directly and indirectly, as chairman of the department, in much of the agricultural engineering research which took place during those years and felt that the oral history memoir would make a permanent record of his recollections.

Dean Bainer's memory was excellent; e.g. he recalled geographic place names in both Great Britain and Japan after a thirty-year lapse of time. His enthusiasm carried into coffee breaks during the taping and he would recount experiences knowing that he would be called upon to repeat them when the tape recorder was turned back on. It is hoped that evidence of his enthusiastic delivery has carried over to the transcript.

The tapes were transcribed by experienced Berkeley transcriber Gloria Dolan who was trained in the Regional Oral History Office of the Bancroft Library. She was instructed to transcribe almost verbatim. A copy of her instructions is filed with the Shields Library copy of the memoir.

The transcripts were topically edited by the interviewer so that out of context afterthoughts wereplaced with similar subject matter. Geographic and proper names were checked for correct spelling and other minor errors of the transcriber were corrected. No change was made in content or style and the memoir reflects as faithfully as possible the personality of Roy Bainer.

Editing by Mr. Bainer included the correction of misspelled proper names and the addition of first names or initials. He also corrected some errors of fact; however, he was careful not to change the informal conversational style which remains throughout the memoir. Mrs. Herman Spieth, consulting editor, made suggestions regarding the correcting of typographical and other errors should a second edition be forthcoming.

The index was prepared by Nancy Nolan, assistant head, Oral History Center, and the pages were bound by the University of California Press.

From the interviews with friends and colleagues and from the taping sessions, a composite impression of Mr. Bainer was formed. He appears to be a man of contagious enthusiasm, yet not impulsive, who rarely if ever makes rash promises and usually makes good on a promise. Conservative by Midwest tradition and by his own nature, yet he is no activist politically. Roy Bainer is a good talker, yet an equally good listener though handicapped in recent years by some hearing loss. His former students said that Professor Bainer "had time" for them; this characteristic was also stressed by his colleagues and friends. He gave subordinates plenty of rope and was perhaps over lenient with the mediocre ones. Bainer hated to "fire" anyone or even to give a needed reprimand.

His greatest satisfaction seems to lie in the solving of engineering problems for industry, faculty, or student. He is a pragmatist and likes to make things work. He was able to bring together people who were compatible and formed a good team on projects and then to guide these teams of researchers. He was familiar with every detail in each project in his department and was eager to be of help when his assistance was requested.

Bainer enjoys playing piano and organ and has been the pianist for the Davis Rotary Club for more than thirty-five years. He taught himself conversational Spanish from Spanish language records and his musician's ear caught the correct pronunciation and accent.

He is virtually "unflappable." When flying to England in war time, an engine went out requiring endless circling to use up the excess gas before an emergency landing could be made; Bainer seems concerned only with the waste of rationed gas. In Cuba, after facing Cuban guards with drawn revolvers, that night he slept like a baby while his roommate was sick with apprehension and unable to sleep at all. His only stress word is "criminy."

A modest man, he cannot bring himself to say Bainer Hall but refers to it as the engineering building or occasionally as Walker Hall, the name of the building used for agricultural engineering before Bainer Hall was built.

He is a collaborator, a cooperative man who pours oil on troubled waters and uses a soft answer, a trouble shooter and a peacemaker. Interviewing him was a delightful assignment for the interviewer.

Avrom I. Dickman
Head
Oral History Center

Roy Bainer — Age 4

FAMILY and EARLY YEARS

Ancestors

Bainer: I was born on a farm about eight miles north of Pomona, Kansas, which is in Franklin County, on March the 7th 1902.

Dickman: Will you say something about your antecedents -- your grandparents or perhaps even your great grandparents?

Bainer: Of course, my family tree is pretty sketchy. One uncle did make an attempt to put down a few notes at the insistence of my father after he was in a wheelchair. I find that he spent more time with his mother, my grandmother, than the rest of the boys because of an illness that kept him in the house quite a bit. His mother told him many of the things that happened relative to her father and mother and my great grandfather on my father's side. I think that the most outstanding or most interesting of all my ancestors was my great grandmother, who was born in Alsace-Lorraine as far as I can determine, and went to the University of Berlin and studied medicine and graduated with a degree in medicine.

According to this write up of my uncle's, the fact that she was a woman made it very difficult for her to obtain a license to operate as a physician so she immigrated as a single woman with her two brothers to the United States.

Dickman: What year would that be?

Bainer: I don't know. I have no idea, but it would be I suppose around 1850. But she passed the medical examinations that were necessary for anyone to practice in the state of New York, and was admitted to practice and hung up her shingle and started practicing medicine near the town of Troy.

It was later that she met my great grandfather who had also immigrated with his parents to New York state from Germany, and they were married and raised a family of I think it was five, and all the while that she had the role of mother, she also acted as the doctor in the area for the whole period of her life. Naturally, I certainly would have been pleased to have made her acquaintance because she was truly a pioneer and wasn't to be thwarted in her ambitions and I think it took quite a little bit of courage for a single woman to emigrate and start all over in a new world.

Immediate Family and Childhood

Dickman: How many brothers and sisters do you have?

Bainer: I had one brother (Robert Eugene) who was 18 months younger that I, and a sister (Martha Ruth) who was 17 months younger than he. My brother was a high school drop out and never did continue his education. It really was his fault because our parents were able to help.

My sister was a graduate of Kansas State University in music -- public school music -- she finished in 1928, two years after I got my Bachelor's degree. She married one of my classmates who was an electrical engineer. He spent his entire life in research at General Electric. They lived in Schenectady, New York, for about 25 of those years, and then during the decentralization of General Electric he was moved to Syracuse. I guess they had lived in Syracuse about eight or nine years when he decided to retire. After he retired, my sister passed away. My brother had preceded her in death by about seven years. So I'm the only one left in my family.

Dickman: Did your father and mother come from large families?

Bainer: Yes, my mother was the oldest in a family of 10 children. This meant that her youngest brother was only about two years older than I. I never could think of calling him uncle. He was just called Ray. I never felt any relationship of uncle-nephew there. She had six brothers (Jess, Sime, Orval, Ben, Walter and Ray), and two living sisters (Martha and Ethel). The sister next to her went to Kansas State University with her and graduated in 1901. The other sister married a farmer and the brothers were all farmers. One of them eventually went into the ministry. But it was a big family and a very congenial one. As a kid growing up we visited my grandparents every summer and I can remember the first time I went there I think there was at least three boys still unmarried. Eventually all of them were married and it wasn't so much fun to go there afterwards. But it was always a wonderful experience to go and do whatever little chores I could do around the farm and be associated with these uncles.

My father went to Manhattan, to Kansas State Agricultural College (as they called it in that day , and now it's known as Kansas State University) in 1896. He graduated in 1900. I don't know the connection, if there was any connection, between my

Bainer: father and my mother in those early days. They lived about six miles apart and they probably knew each other, but I never was told whether they were courting each other at that time or not. In 1897, my mother and her sister, decided they'd go to Kansas State Agricultural College. Then, in 1900, when my father graduated, he and my mother were married, and she never did get to finish, but her sister continued on and finished in the class of 1901.

I remember my aunt was a very loyal Kansas Stater. She hardly ever missed a commencement. When my aunt had her fiftieth anniversary of her graduation, it was my twenty-fifth, and she wrote me a special letter that I just had to come and help her celebrate her fiftieth because it was my twenty-fifth. And do you know, I've never been back to that institution for a single reunion -- class reunion -- since I left, and I kept telling everybody, "Well, I'll go back for my fiftieth."

Dickman: Did you go back?

Bainer: No, I regret it very much, because it meant so much to her. And here it was my twenty-fifth. She just couldn't understand why I wouldn't make the effort for my twenty-fifth, and especially since it was her fiftieth, you see.

Dickman: Have you been back since?

Bainer: Yes, I've been back to Manhattan, but not for a reunion.

Dickman: You were honored?

Bainer: Yes, I was honored by Kansas State in 1960 with an Outstanding Achievement Award.

My father had three brothers (Fred, Chauncey and Clarence.) There were two girls born to the family. Both of them passed away. My father was the oldest of the four boys, and to my knowledge, only Clarence is still alive. He lived in Tennessee, the last I heard. The rest of them have passed on.

Dickman: Do you have any children?

Bainer: Only one, La Nelle Marie. She was born in Woodland, and went through Davis schools where she was an honor student. Two boys tied for first place and she was second. She went on to the University of California at Berkeley and graduated in home economics in child welfare. After finishing, she went back for one graduate year to get her teaching credential.

Bainer: She's now teaching remedial reading in the Dewitt clinic at San Rafael -- they have farmed her out to the Dominican school to teach remedial reading to several grades, and she enjoys this. More recently (1973) she is teaching in San Francisco.

Dickman: Let's get back to your parents.

Bainer: My father and mother were married in 1900. He was going to serve as a herdsman at the college for one year in order for my mother to finish her education, which she actually never did.

They moved from Manhattan, Kansas, to a farm about eight miles north of Pomona, and in 1902 I was born on this farm.

Dickman: How far is that from Ottawa?

Bainer: About ten miles. A year later, my father and his brother-in-law (Jess Nitcher) decided to try their hand at dairying near Trenton, Missouri. A couple of years later my father felt he'd be better off if he had more education, so he applied to Iowa State College at Ames for permission to take a master's degree in agricultural engineering, which was a new program at that institution.

I actually have in my possession the letter that he wrote making his application. It related all the things he was going to do to earn this master's degree, which really surprised me to no end.

Well, he received his MS degree in 1906. It was the first master's degree ever awarded by Iowa State College in agricultural engineering. It was more of a farm mechanics sort of a degree than we think of as agricultural engineering today. After serving on the faculty of Iowa State College for a year or so --

Dickman: -- where, incidentally, he taught Ben Madson [long time Prof. of Agronomy at Davis] --

Bainer: --that's right, both Ben Madson and Hal Higgins* took courses from him -- he moved to Fort Collins, Colorado, and headed up a department that was actually called farm mechanics.

* Collector of Agricultural Memorabilia now in the UCD Library.

Dickman: Where was that?

Bainer: Fort Collins, Colorado State College, it's now Colorado State University. He was there for four years. And then he left the teaching profession. He took a position with the Santa Fe Railroad at Amarillo, Texas to head up a new department of agricultural relations. In those days, of course, that was before there were farm advisors in counties, he might have been classified as an extension man, because he was advising farmers along the railroad on how to increase production so there'd be more tonnage for the railroad to handle. He organized the first boys and girls clubs, and the Santa Fe gave prizes for producing the most grain, sorghum or corn per acre. On many occasions, I helped my father measure these yields. He wrote lots of agricultural bulletins on various crops.

In 1916, we moved to Topeka, Kansas, which was the headquarters of Santa Fe, and he actually began to expand in the industrial end of the railroad's interest. By that, I mean that he would promote the location of industry along the Santa Fe tracks in order to increase the tonnage.

In 1918, following the war, my father left the Santa Fe Railroad and took over the management of a 16000 acre property near Scott City, Kansas, where they were developing irrigated farms. These 16000 acres were owned by two brothers -- the Mark brothers. They had an iron and steel business and manufactured steel pipe in about four locations. They had, as a hobby, bought this land over a period, and they'd accumulated about 16000 acres. The land was actually located in an area where there was shallow water, and could be irrigated. The wells were only about 90-100 feet, but they'd yield as much as a thousand gallon per minute.

So he ran this operation over a number of years, and that was where I got my first taste of farming. After about ten years, as an operator of this farming company, he left the farm and went to Kansas City to head up a wheat improvement association program. And this lasted a couple of years. Then we got into the Depression and wheat went down to twenty-five cents a bushel. There wasn't much support for improving the quality of wheat, so he took a position with a large bank in Kansas City.

They were having a problem with their farmer loans. They had about a hundred farms in northern Missouri which were on the verge of bankruptcy. They didn't want to foreclose on these people. They thought these people might do better if they had a little guidance. My father's problem was to advise these

Bainer: farmers on improved methods and better organization, and attempt to save the farmer from losing his place.

Dickman: When was this?

Bainer: This was during the Depression, in the early '30s.

One day my father was in Chicago and went in to see the president of the Santa Fe Railroad and indicated that he was available, and that if they ever had an opening in the agricultural department of the railroad, that he would like to be considered.

Well, it wasn't very long 'til the man that headed up this department died, and my father got a quick call from Chicago. By that time he was 65 years of age, and the railroad said "we can't hire you back at this advanced age, but we can turn your age back five years on our records." So they did and hired him. He went back to Amarillo where he had started and resumed the old job that he had left years before. He was still active and would have retired at the age of 72, had he not had a heart attack and died on the platform of the Grand Central Station in New York, while changing trains.

The interesting thing was that while he'd never been sick in his life, he had, I suppose in his advanced years, conditions that the Santa Fe doctors had been advising in one way or another. One of the things that the doctors had told him was not to carry heavy bags when he was travelling. On this particular morning he was a little late and was about to miss his train. A red cap wasn't available, so he picked up the two bags and started down the platform and that was it.

Dickman: He was a remarkable man. He started with Santa Fe when Santa Fe was still pretty young as a railroad. Do you remember any of the stories that he would tell you about Santa Fe?

Bainer: Well, one of the things that he did for Santa Fe -- they were still building their railroad at that time -- was to go out and classify the land and determine its productivity. So they put the railroad line in an area which had the greatest potential for production. He located what was known as the Ochiltree-Hansford Branch in the panhandle of Texas, and he located the Coleman cutoff between Clovis, N.M. and Lubbock, Texas. In those days there were no graded roads, but he had an automobile. The Santa Fe furnished him first with a 1908 Maxwell, and he had problems keeping that one going.

Then they turned that in and bought him a 1911 Cadillac, with a hand crank. When he went out to work with the farmers, or to

Bainer: classify land, or whatever he was doing, in the summers, he took me with him to open gates. And I never knew a man that had such a sense of direction on those plains as my dad. He'd go through a gate, and there'd be a little indistinct road off this way, and another off that way, and I never knew him to ever take the wrong road. And when you ended up at night at a ranch, you were expected to stay all night. They put you up in the bunkhouse, and gave you the gol darndest feed you ever saw.

So he had this rather interesting experience, there. He initiated what was known as demonstration trains, and I remember in 1916 they had an epidemic of the Hessian fly in Kansas; Hessian fly was a pest on wheat. There were control measures that were known, but the farmers weren't using them. So my father made arrangements with the state agricultural college to furnish the expertise on Hessian flies and they ran a Hessian fly special for two weeks through the wheat belt. They would pre-advertise this thing, and the farmers just turned out in droves. They used regular railroad coaches as classrooms, with a lectern in the end. They'd carry in the demonstration cars Hessian fly control measures and so forth. That train was a precursor of Farm Extension, really -- getting the story out to the farmers all through the wheat belt.

I rode on some of those trains. My job (I was only fourteen years old) was to hand out literature and count people. They always wanted to know how many people came.

I lived in a private car; you know, they had this business car which would sleep about six or eight. I always had to sleep in an upper berth, but that didn't bother me [laughter]. Well, my Dad ran what was known as a cow, hen and hog special. They were very successful, and finally, you know, Davis got involved with the Southern Pacific many years later. I don't think the Santa Fe ran one in California, but they ran them in Texas and also through Kansas and Oklahoma. They were all done in cooperation with the agriculture colleges. The Santa Fe furnished the train, and it was my Dad's responsibility to arrange for speakers and to see that this train operated properly. These people were taken care of, and the Santa Fe gave them transportation and fed them. It was a joint effort between the colleges and the railroad. Well, other railroads started doing it.

The Rock Island Railroad hired another professor from Colorado by the name of W. H. Olin. He had the same responsibility as

Bainer: my dad, but they never did have the program that the Santa Fe had.

I used to go out with my dad in the summer harvest to judge acre plots of different crops put in by kids competing in Santa Fe contests. My father got acquainted and influenced a lot of people. Sam Lyle, who reached a top position in the USDA, was one of these kids. He furnished daily samples of silage for demonstration purposes in connection with demonstration trains. Sam told me many years later, "I would never have gone to college if it had not been for your dad." He went to Kansas State and graduated the year before I did. So, as I say, he had an influence, and even the Future Farmers of America gave him one of their highest awards for his early contribution to club work.

Dickman: How about your younger brother, did he have this same kind of an interest?

Bainer: No, my younger brother was a problem to the family. He never stayed with anything, until he got married, and that was the turning point in his life. He was very successful in later years, but as a kid growing up -- he never finished high school. He was the smartest one in the family, really. I think he had the best brains of any of us. My dad set him up in farming and it lasted about a year. He set up a confectionary, but he just couldn't settle down to anything. He finally met and married a girl (Mabel Bickel) in Jetmore, Kansas, and she just was what he needed. They had six children, and he began acquiring property in eastern Colorado. He was a business man, he really was. At one time he had control of 25,000 acres. Another venture was a motel in Colorado Springs that he sold for a profit of $50,000 in less than a year.

You never saw six kids who walked the chalk the way his kids did. He got by with murder, you see, but not his kids. When they got ready to go to college, he moved the whole family into Fort Collins so they could attend Colorado State. He always blamed my parents for not standing over him with a baseball bat and forcing him to go to school. He was one of my best publicity agents, really. He always seemed to be so proud of what I was doing, you know. And his kids just worshiped me. I really had a big time with them.

Dickman: What's this feud that was running between you and your brother-in-law Don B. Lang? I read this amusing newspaper article that your daughter clipped and saved in the scrapbook.

Bainer: Oh, well, that wasn't really a feud. Maybe there was a little jealousy at times. No, it really wasn't a feud. We were the

Bainer: best friends in the world, but every once in a while you got a jibe from him, and I was very careful when I was around him. [Laughter] I didn't say anything in any boastful manner or anything like that. He was a lawyer. He was president of the Bar Association in Kansas. We spent many weeks together, either in Kansas or here. He was a great guy. He had an aneurism, and they put in about 16 inches of a plastic aorta. He was back in for a check up at the Kansas University Hospital in Kansas City, about eight years later. Just as he was waiting to go into the doctor's office, he'd been watching television and said to his wife, "You know, I just don't feel good." And that darned thing broke right there in the office, and they could not save him.

Dickman: What year was that?

Bainer: Oh, that was about six or seven years ago.

Dickman: Did you ever get into any trouble when you were a kid?

Bainer: Oh, yes, I -- of course, my brother and I fought when we were little.

Dickman: How many years difference?

Bainer: Just eighteen months! And I can remember, he'd always come to my rescue, however, when I was having trouble with another kid. I remember one time he threw a brick at one of these kids and hit me, and then he felt awful about that. [Laughter] But we used to fight over who was going to sleep on which side of the bed. We always had to share a bed together. As I say, we never were the palsy-walsy type even though we were that close together in age. He had his friends and I had mine.

My sister was a very neutral person; she got along with both of us very, very well. In fact, my sister lived in the house with my wife and I the first two years we were married. She was two years behind me in college. We rented this house furnished from my parents, because my mother finally decided to go to Kansas City to live with my dad where he was working. She was keeping house for my sister and I when we were in college. When I got married my mother said, "Well, you're not expected to keep house for your sister, but if you want to rent the house we'll give it to you for a certain amount provided your sister has a room," and she fixed up a little kitchen facility in the basement so that she could do her own cooking.

Dickman: Besides getting hit by a brick, any other trouble?

Bainer: Oh, one time we -- I don't know who the other kid was, but the two of us went into a shed, in back of a neighbor's house across the street, and ran into a lot of fishing tackle. Well, this was the most attractive stuff I'd ever seen. I wasn't a fisherman, and why I needed this tackle I don't know, but here was this beautiful tackle. I suppose I was eleven or twelve years old. Well some of it went in my pocket, and I went home. My mother immediately discovered it and wanted to know where it came from. I told her, and of course I had to go back and deliver the tackle and apologize for picking it up. [Laughter] I remember how gracious these people were, about the whole thing, that I had come in and owned up to the theft. It was a good lesson, and I realized that if you did get in trouble, you'd better get out of it as fast as you can. That was the only time I ever got in trouble.

Dickman: Any other relatives that were close to you? Any uncles or aunts?

Bainer: This aunt that went to college with my mother married very late in life. She taught school. One of the years that we were in Fort Collins, my mother had inflammatory rheumatism which made her bed-ridden for quite a while, and this aunt came and lived with us. For some reason or another there was a very close attachment between us. We were pals. Everytime I was around Ames, Iowa I always went to Roland and spent a night or so with her. And we corresponded. You know, it's a funny thing, I corresponded with this aunt 'til she died. We weren't together too much, but there was just some common bond between us. I would say that the two people who had the biggest influence, or three people, my aunt and my father and mother, who in a very subtle way could kind of keep you going in the right direction. It never really bothered her that I lived two thousand miles away just as long as I was doing all right.

Dickman: Didn't you take music lessons when a kid?

Bainer: Yes, as a kid I can remember back in Fort Collins my mother bought a pump organ and was going to learn to play it. She took a few lessons but she had too many family duties to get very far with the organ. About that time my father left the college to take a job with the Santa Fe Railroad in Amarillo, Texas. By that time my mother had decided that she really wasn't going to be an organist so she shipped her organ to her younger sister.

One of the first things my mother did after arriving in Amarillo, was to buy a piano. While she'd given up herself, she was going to see that the rest of us learn to play the piano, so

Bainer: the first thing I knew I was taking piano lessons and boy how I hated it. It interfered with my other activities to have to practice. I took lessons on and off, but I never was going to be a pianist, I really never was. So when I went to college, I took piano lessons for one semester and I decided that wasn't for me. Since I was playing in the band and I switched from piano to the horn.

Well then, of course, I moved out to California and all of this time I didn't have a piano available. During the depression you could pick up pianos pretty cheap by paying up the balance on a repossessed instrument. They were bringing pianos back to the dealers regularly. We bought a very lovely repossessed Baldwin piano for only $345. I just had had enough music that I could play a little popular stuff.

Dickman: Let's go back to your boyhood days.

Bainer: As a kid growing up I always managed to have a job, and for years I carried a Saturday Evening Post, Country Gentlemen, and Lady's Home Journal route. This was always done on Thursdays. I was quite successful in this experience, and I had some real substantial citizens as my customers. I was even appointed to the League of Curtis Salesmen. I had the general office building of the Santa Fe Railroad before they put newstands in a lot of those office buildings. I remember -- my father's office was in it -- and I noticed on the wall that peddlers and salesmen were banned from soliciting in this building, so I wouldn't think of going even into the hall of the building. I always stood out in front.

Dickman: How old were you?

Bainer: Oh, about 12 years old. Well, anyway, it was a cold morning, it could get cold -- this was in Amarillo, Texas, and it could get cold. We use to say there was nothing between Amarillo and the North Pole but a barbed wire fence. We were up there on the high plains, 3600 feet elevation, and the wind came down from the north. One of those bitter mornings I was out on the sidewalk in front selling the Post. I got there about fifteen or twenty minutes early. Fred C. Fox, the general manager, came along, and said, "Boy, you shouldn't be out here in this cold. Why don't you get in by the radiator, it's a lot warmer there."

Well, from then on I stood by the radiator in the winter time to sell my Post. He was one of my customers.

Bainer: The agency where I got my Saturday Evening Post was kind of a confectionary and news stand, and they finally persuaded me to jerk soda in there on Saturday nights. The local grocery store, a couple of blocks from where we lived, needed help on the weekend, and I used to work Friday afternoon after school and all day Saturday at this grocery store. Our duty Friday night was packaging potatoes and sugar (that was before they came in separate packages) and helping with the deliveries. Then Thanksgiving and Christmas we had a busy time picking turkeys. I never got so tired of picking turkeys in my life [laughter]. They ran a meat market and they processed all their own turkeys. It was something to keep me busy.

Well, after my freshman year in high school I decided that I'd like to work at the U. S. Experiment Station that was on the edge of Amarillo. The cereal station did research on all types of grains that could be produced on the high plains. I went out to the superintendent and applied for a job after school was out that summer. He had apparently hired a lot of kids, and was a very obliging fellow. He said, "Well, as long as you can do a man's work, you've got the job here at a dollar a day."

And so I started work, and the first month I got a dollar a day. And I said, "Boy, a million days, a million dollars." [Laughter] That was a lot of dough! The main job was hoeing weeds. When they got into threshing I helped with the plot threshing and cleaning up the machine. I found the need for absolute care to prevent mixtures of grain.

I got a lot of fundamentals of research in agronomy. Well the next month they raised my pay to a dollar and a half and the next month to two dollars. I worked with two other fellows (Bob Crugington and Guy Owens) who were a little older than I. Both of them were going to the University of Texas.

Dickman: How old were you?

Bainer: Well, that was 1915, so I was 13 years old. Bob became a lawyer, and Guy became a doctor. They both went to the Univeristy of Texas, and of course, they always wondered where I was going. Well, I was going to go to Kansas State, even though I lived in Amarillo, primarily because my father and mother and aunt went there, and I did, eventually, as you know.

I worked there all the next summer. Then by the third summer, was transferred to Topeka. Due to my father's position on the railroad, I was entitled to an annual pass. Well, I had free transportation anywhere on the Santa Fe system, and -- here I

Bainer: was living in Topeka (this was after my junior year in high school). I wanted to go back there and work and wrote the superintendent and he said, "Well, if you want to come down, I'll get you a regular appointment at seventy dollars a month, and your transportation isn't going to cost you anything. We will board and room you here for twenty dollars a month." So, I still made fifty dollars a month.

There was one interesting incident. After I'd been away from home at Amarillo this third summer, I'd never been away from home for any length of time, and my golly, at the end of a month and a half I got homesick, and I just had to go home -- it just hit me all of a sudden. So I told the superintendent, if it was alright with him, I thought I'd go home Friday night. It was just an overnight trip to Topeka and I'd come back on Monday morning.

I'll never forget getting on that train. I got a pullman, because my transporation wasn't costing me anything. The minute that train pulled out, my homesickness was completely over. I thought, what a wild goose chase this is. I remember how surprised my mother was when I walked through the door the next day. She said, "What did you do, lose your job?" I said, "No, I just thought I'd come home for the weekend." Sunday night I went back and went to work Monday morning. [Laughter]

Dickman: No more homesickness.

Bainer: No more homesickness, and that's the only time in my life I ever got homesick. But I was really a homesick kid. And I cured it in short order.

Dickman: What kind of appointment did you have the third summer?

Bainer: It was a regular appointment rather than a day by day thing. Seventy dollars a month, which was still [laughter] pretty good money for a kid, you know. The interesting reaction to this thing was I was to get a day and a quarter paid vacation for every month I worked. [Laughter] I'll never forget that. So at the end of the three months, I had almost four days of paid vacation. I wanted to be sure that I got this vacation: I wanted to do something special. I talked with another young chap (Leo Stump) who worked on the station and we decided that we'd go down to Galveston on the Gulf of Mexico, and swim. So I wrote my folks and told them that before I came back to Topeka to go to high school that fall, that Leo Stump and I were going to Galveston and spend three days. Of course, again, the Santa Fe ran into Galveston, so it didn't cost me anything for transportation. Well, my mother wrote back and said, "I

Bainer: think it's a fine idea. Your brother Bob hasn't been anyplace this summer. Is is OK if he comes down and goes with you?" So I said, "Oh, sure, that would be fine," and so my brother came down on the night train and we met him in the morning and caught another train and went to Galveston for the three day paid vacation. That was the first paid vacation that I ever had. [Laughter]

Dickman: At age 15.

Bainer: Yes. We had a big time. We swam and ate oysters. We stayed in what was probably a third rate hotel, but it was clean. This chap who went with us had never been any place. It was a real treat for him, and he marveled at the way we could get around. He'd never been away from home.

A High School Farmer

Dickman: Do you remember any of your high school teachers?

Bainer: One doesn't always remember all of his high school instructors, but in this one particular case I'll probably never forget one. Her name was Abigail McElroy. She was the teacher in botany. She was really a thorough teacher, and I learned a lot about this subject from her. I volunteered the family automobile and took her to the field on Saturdays to gather plants of all kinds for use in the classroom. It was just an extra session in botany. Everytime we went to the field she pointed out a lot of things that we had never covered in class. When I went to college I found that anyone that had taken Miss McElroy's botany course at Topeka high school was exempt from Botany I-A at Kansas State University. This is how good her reputation was even at the university.

Well, after I graduated from college I happened to be in Topeka for a short period and visited the high school and ran on to one or two of my teachers. One of them, of course, was Miss McElroy. It was one o'clock and she'd just taken up the botany lab session. I knocked on the door and thought it was a little bit embarrassing because she had to leave the class to come out. Well, she came out and it happened to be at the time that I had resigned at Kansas State and had accepted a position at the University of California, and she naturally asked me what I was doing and I told her. I never saw anyone so proud of a student

Working his way through college as a wheat farmer.

Bainer: as she was. One of her proteges was going to go to the University of California as an assistant professor. She certainly gave me a background in plants that I never would have had otherwise.

Well, I don't know where to begin on my own farming operation. The thing that most people are surprised to find out; I was a high school dropout during the fall of 1918. We had an influenza epidemic. I was a senior in high school, and the schools were closed and I got a job. I worked cashiering in the Tully-MacFarland drug store in Topeka. When school resumed in the spring, we all went back to class and suddenly discovered the teachers had expected us to study at home and advance ourselves in our books. Since I had been working, it was impossible to catch up with the class so I dropped out.

This all happened about the time my father took this position in western Kansas to develop the irrigated land. So, in the spring of 1919, my father had gone to Scott City, ahead of the family. My mother had stayed at Topeka because of my brother and sister being in school, and weren't going to get out until spring.

Being out of school, my father insisted I come to Scott City and live with him until the family came. We set up a partnership in which he furnished the money and I furnished the labor and we went fifty-fifty- on the farming operation. He was my advisor and business agent. He rented the land that I needed to farm and he bought the equipment. He maintained that I'd be better off working for myself than working for this big ranch that he was working for. Their wages at the time I remember were about thirty cents an hour, and that was pretty low.

I had my first crop in 1920 from two hundred and twenty acres of winter wheat. This yielded eight thousand bushels of wheat. Wheat at that time brought $2.40 a bushel. For an eighteen year old kid that wasn't too bad, and I began to think that it was just as well I dropped out of school, and that I didn't need any more education.

A Turning Point

Bainer: But my mother was a very patient woman, and yet very disappointed that her eldest son had decided not to go any further in school. She suggested that I spend a couple of months at Kansas State

Bainer: Agricultural College in Manhattan attending what was then known as the farmer short course. She said, "You need to get acquainted with people who are authorities in agriculture, they probably can help you quite a bit."

So in January, 1921 I decided to attend the farmer short course. I hadn't been in Manhattan more than a weekend -- actually I got in there Friday and something about it was contagious. I wrote home Sunday night and told them what a fool I'd been to pass up an opportunity of going to college and I thought I'd go back to school in the fall of '21.

So I went over to see the registrar, and she went over my high school records. I had attended an automobile school for which she gave me credit but I still lacked just about a year. I hadn't had any advanced algebra, trigonometry, or physics, some of the subjects you had to have to get into college. They had a prep school at Kansas State College at that time, which was really a three year high school known as the School of Agriculture. It no longer exists. However, in those days, many high schools in the state didn't give all of the subjects that you needed for college entrance, and you could go there to make up deficiences.

So I made arrangements to enroll in the school of agriculture. I'll tell you it was pretty rough getting back into math and physics. I think it had been seven years since I'd had the first course in Algebra, and to take a course in advanced algebra just about floored me. I almost went home half a dozen times. But for some reason or another I stuck it out and finished up and got the equivalent of a high school diploma and then I entered the four year program.

Dickman: What made you stick it out, do you have any idea? Did you have any friends who tried to give you encouragement besides you mother?

Bainer: No, I'd made a committment, you see, and by that time I had my own money and drove my own automobile. I was one of the few kids on the campus who had an automobile. And I felt that I just needed this experience, and I think it was just to save face, more than anything else. And then, once I did break through, and it all seemed like it happened over a period of two or three weeks, everything started coming back, then there wasn't any problem.

There was one important incident in that experience. In the spring of '22 I was rooming with a boy from my home town by

Bainer: the name of Frank Robb. He was in civil engineering. He didn't intend to go more than a couple of years, and this was his last year. Professor Walker (for whom Walker Hall on this campus was later named) had started a new program in agricultural engineering (that was the first year it was offered) as a curriculum in the college of engineering [at Kansas State College]. He was offering for the first time, a course known as Elements of Irrigation and Drainage. He had been the state water resource engineer seventeen years, before he joined the faculty at K. State. My roommate wanted to take the course, he and one other civil engineer.

After the first meeting of the class, my roommate came back and said, "You know, I think Professor Walker wants to give this course, but only two showed up. He said if we could find one more, he could give it. Why don't you take it?"

"Well," I said, "very simple why I don't take it. One of the pre-requisites for this is surveying, and the pre-requisite for surveying is trigonometry, which I'm just now taking. I don't have any hopes. I'd like to take the course, but it just isn't possible."

Well, you know, this fellow went over and talked to Professor Walker and told him about my background in farming with tractors, in western Kansas, on this irrigated farm -- we had our own water, and laid out irrigation systems. My father always did the transit work and I held the rod for him. I knew something about surveying. Anyway, Professor Walker told this fellow that he thought during the course of the lab periods he could teach me all I needed to know about running a level and for me to enroll.

And so I went in to see the principal of the school of ag, and told him I wanted to add this course of Walker's to my program. As I remember, I had 18 units, which was a load anyway, and that would make me 21 units. He just threw up his hands and said, "This just isn't possible!" I said, "Well, Professor Walker told my roommate that he'd be very glad to have me in his class."

I'll never forget that guy whirling around, grabbing the telephone, calling Professor Walker. He was going to make a liar out of me right now, and how he toned down when Professor Walker explained the situation: That this was the first time he'd given the course and he wanted to give it very badly, and he could teach me all I needed to know about surveying in the lab period or maybe an extra period. He said, "I'm willing to help the boy."

Bainer: So, I enrolled in this course under Professor Walker, who was then the head of the new department of agricultural engineering. With only three in the class, we received much individual attention. Toward the end of the semester, Professor Walker asked, "What are you going to take when you come back next fall?" "Well," I said, "I guess I'll go into electrical engineering." That seemed to be the real thing in those days. He gave me a fatherly talk, and he said, "Boy, I want to tell you something. With your background and your experience that you picked up from your tractor operations (I never owned a horse, it was always tractor farming from beginning to end), and your interest in irrigated farming, the whole thing just makes you a natural for agricultural engineering."

Well, I had never heard of ag. engineering, oh, just indirectly from my dad, you know -- but I didn't even know they had a program in agricultural engineering at Manhattan.

STUDENT LIFE AT KANSAS STATE COLLEGE AND SIDELIGHTS ON TRACTORS

Bainer: So I went back that fall (1922) and entered the program of agricultural engineering [at Kansas State College] and at the same time I kept the farming operation going. We harvested the wheat in July and we planted in October. We could do all the field work in the summer and it took nine months to grow the crop while I went to school. So, I raised 16,000 bushels of wheat while I was in college. I think the experience that I got, just bulling my way through, learning how to run the tractor, learning how to keep it in operation, those were really rough times with tractors in those days as compared with tractors today.

Dickman: No roll bar on them?

Bainer: Oh, no. No rubber tires, lights or starters on them. You cranked them, and you didn't always know if you could get the tractor started when you went out in the morning. And there were days when I didn't get the tractor started.

My first tractor was a Titan 10-20 made by International Harvester Co. It had a large fly wheel and I had a little pick-up truck that I built myself. I'd taken an old Ford touring car and cut the body in the middle and left the front seat and put a box on the chassis in the back just for a trap wagon.

Bainer: I carried a rope, and when I had trouble starting the tractor, I'd wrap the rope around the fly wheel eight or ten times, and tie it to the pick up, and take off down through the fields spinning it, and boy, I could usually start it.

Dickman: Either that or the rope would bust. [Laughter]

Bainer: [Laughter] Yes, there's a lot of this, just a lot of experience in that farming venture that should be related, because it was part of my education.

Dickman: Sure, it was very relevant to what happened later.

Bainer: One of the things that happened was that one of the Mark brothers used to come out periodically, and his problem, (which was my father's problem, actually) was finding qualified people that could keep their big pump engines running and keep tractors going, but mainly pump engines. They had big single cylinder engines that developed 60 to 90 horse power in a single cylinder at slow speed which made a pretty big engine.

I remember that each fly wheel on that old Charter engine weighed a ton and a half. This fellow also observed my farming operation when he come out and he was very much interested in the whole thing even though his background and whole livelihood was steel pipe manufacturing; he just loved to come out there and get in easy clothes and spend some time.

And so, I think it was the winter of 1919 [two years prior to enrolling at Kansas State] Mark suggested to my dad that he'd like to pay my expenses and make arrangements for me to go to Sterling, Illinois, and spend a month or two during the winter, on the assembly and test floor of the Charter Gas Engine factory. He made the arrangements, and I went to the Charter factory. It was free labor for them, because I was just working in there for experience and Mark was paying my expenses. I was to get first hand information on their engines, so that when a problem developed with an engine in the field, they had at least somebody they could call on. I wasn't working for them steady, but I was subject to call. So I worked in the small engine factory, on the assembly floor and test floor, where engines were put together from beginning to end. Every Saturday morning we all worked in the foundry, pouring iron into molds to make the castings that these engines were manufactured from. So the engine was made from pig iron, and the finished product was tested right there.

Bainer: I went home that year, and when they had a problem with the engines I was subject to call. The next year Mark bought some hot bulb engines. They worked on a two stroke cycle that carried enough heat over in a hot bulb to ignite the fuel on the next stroke. You had to pre-heat the bulb to get it started, and then the bulb stayed hot while it was in operation. He felt that I had had such good luck with the old Charter engines the he would like to have me learn about the Venn-Severin hot bulb engine. He sent me to Chicago [Venn-Severin Engine Co.] in 1920. I worked mainly on the test floor. I remember the examination that they insisted I take before I went back home, and they really doctored up an engine -- everything possible was wrong with it, and my problem was to get that engine going.

I went home, and you know, I was working on my own, but was subject to call when they had problems with their engines. I found that the best thing that I could do was to make a regular inspection of these engines. They shut them down at midnight on Saturday night, and started them the same time on Sunday night. They always gave everybody Sunday off. That was the time that I could go in unbothered, you know, and start these engines and tune them up. So I used to spend the time the other guys were off, trying to keep these engines running another week.

I had another experience. In 1920, I bought the first Twin-City, 12-20, tractor that came to the county. The dealer brought in five, and he traded me out of my old Titan tractor.

Dickman: Used your own money to buy it?

Bainer: Yes, sir. It was a 16 valve engine. It was really the peppiest little tractor you could imagine, but lots of things could go wrong with it. Since I bought the first one, I was first to have problems (everyone of these tractors had certain idiocyncracies that were involved) but I had the first problems because I had the first tractor, and I was working day and night, practically.

When the dealer had trouble, he'd bring another farmer to see if I could go and help him get his engine going. And the farmer would bring his operator and keep my tractor going. I'd say, "I'm not going and leaving this plowing undone." They'd furnish an operator for me and my tractor just kept on plowing, and I'd go over and work on his tractor for him.

One of the things that I suppose gave people more problems than anything else was the magneto. They had Bosch DU 4 mag-

Bainer: netos that were not very well insulated. Dirt got into them and shorted them out. Nothing else ever went wrong with them except, of course, the breaker points. I learned to take those magnetos apart and wash them out with high test gasoline. Periodic cleaning was necessary to keep my tractor running. But there was a secret, you see, even the magneto has to be timed within itself, and then it had to be timed with the engine. I used to mark the connection on the engine so I could always set it back the way it was. It finally got around that I was an expert in magnetos. I had a little shop in the basement, and almost every week I had some magnetos to clean up. I didn't charge very much. I charged $5.00 to wash one of them out, which I could do in an hour.

Of course, the farmers wouldn't always mark the magneto coupling so then I'd have to go back with them to time it with the engine. So, I learned a lot of things the hard way, and then when I went to college it just amazed me to see how easy some of those things could be figured out if you approached it the right way.

Dickman: Even though this is getting ahead of our story, I've heard of the Johnny Henle tractor affair. Would you mention that?

Bainer: This incidence happened many years later (1934). It had nothing to do with my research or teaching. It simply reflected that early experience I had as a kid on the farm keeping a tractor running. Henle owned the piece of land just across the old channel of Putah Creek where student housing, the Faculty Club and Wyatt Theater are now located. He had fifty-two acres of almonds. These almond trees were planted on old French stock and were bearing at the time the railroad went through. His ancestors had planted them. I'm told that some of the freight rates were established on the basis of shipments from that almond orchard. These were immense trees. It was just a shame to take them down. These almond trees were probably three and four feet in diameter. Oh, they were tremendous trees and really high. Well, Johnny was a very conservative individual, and he operated this farm with a 15-27 John Deere tractor, two cylinder. We used to call them Jumping Johnnies. They had two power strokes on every other revolution, so they even sounded irregular when they ran. Well, he used this tractor to cultivate the orchard, run the almond huller, and run his irrigation pump. The centrifugal pump was in a pit maybe fifteen or twenty feet deep which put it within the suction range of the water table. He drove the pump with a belt from a pulley on the tractor.

Dickman: He really depended on that tractor.

Bainer: Oh yes, he depended on it. And he'd had some problems with it, so he bought a new cylinder block and new pistons, to make almost like new. But he continued to have grief with it. He'd had people come out from Sacramento, and they didn't seem to be able to get it going. I happened to see him down at the bank corner one day; it was along in the middle of the week, and he said, "Do you know anything about John Deere tractors?" I said, "John Deere tractor's are no different from other tractors. I mean, they're all on a four stroke principle." (This was before diesels.) He said, "Well, I'm having trouble with mine. I had a man out there and it's cost me $35, and I still don't have that tractor running. I've got a couple of fellows coming from Dixon, Friday, and I told them if they got it started and running I'd give them $15, and if they didn't I wouldn't give them anything. So they're coming under those conditions." [Laughter]

So I just made a passing remark, I said, "Well, Johnny," (I knew somebody would get this tractor started) "if these fellows from Dixon don't get it started I'll come down and start it for you Saturday afternoon." It was ridiculous, getting out on a limb, sticking my neck out. Well, I was eating lunch Saturday noon, and there was a rap on the door and here was Johnny Henle. And I said, "Well, John, you mean those fellows didn't get it started?" And he said, "No, they didn't." I said, "Well, give me a minute to finish up lunch and I'll change my clothes and we'll go down and start the engine." I had to be firm. [Laughter] He said, "you don't need a change of clothes. I'll do whatever you tell me to do. I'll get dirty, you don't need to get dirty." I said, "I can't work on an engine like that, I'll have to get some overalls on." So I put them on and we went down there. Well, I took ahold of the flywheel of this engine and it wouldn't even move. The cylinders were horizontal, and there were priming cups on them. This was an old style engine. This was way back in the early thirties. Didn't even have rubber tires or a hand crank. You had to start it by pulling on the flywheel by hand. I said, "What's happened?" He said, "You can't turn it over now." I said, "The pistons are stuck in the cylinders."

Well, what had happened, these guys had primed this engine so much with gasoline, they had washed all the lubricant off of the pistons, and they were dry. I said, "Well, John, we've got to break this loose. We'll never get it to run if we don't break it loose. Have you got a two by four around here?" And he went and got a two by four and we tied it to the fly wheel of this engine to give us some leverage. I knew we had to break this thing loose. So I filled the spark plug holes with

Bainer: lubricating oil and let it set a little while, and fortunately the pistons were underneath -- but close enough so that I got some of the oil on the pistons. We finally pulled it over and broke it loose, and then as we rotated it I kept working more and more lubricating oil into the spark plug holes until the pistons were well lubricated and working back and forth in the cylinders. I said, "What does it sound like when it fires Will it fire?" Afterall, I hadn't even checked the timing or anything. "Oh yes," he said, "it fires once in a while." "So," I said, "let's fire it." So we shot a little gasoline in there, pulled it over, and we got a late explosion. I told him that the timing was late. And so he got out the instruction book. I'd never timed a John Deere before. So, I followed the instructions for timing and we timed that thing up and got it right on the button and pulled it over and it started the first time. Oh boy, he was just like a kid. He wanted to stop it and start it. Wanted to be sure he could do it. So we stopped and started it I guess a half dozen times. Then he wanted me to set the tappets on the valves, which I did. As I say, it was just out of time. I adjusted the magneto points, and went home.

He came around and wanted to pay me. I said, "No, John, as a kid growing up on a farm I never saw an engine I couldn't start, you know, and I just wanted to know if I still had that much confidence in still knowing how." There was a fellow named Roy Murry who ran a Shell station over on the corner of First and B, and Johnny used to stop there and chew the fat with him. So, the next day was Sunday, and I went there that morning to pick up my newspaper, and Murry said, "old John Henle was in here a little while ago and was he bragging about getting that engine started. He went over to see if it would start this morning and he was starting and stopping it for hours." The next day I was driving home for lunch and Johnny stopped me. And I said, "You're not having any more trouble with that engine, are you?" "Oh, no." He threw a check in on the seat for $5.00. I said, "I told you I wasn't going to accept any pay. I did this as a neighborly act, and you just tear up the check or I will." "No," he said, "the check isn't for you. The check is for your daughter (who was about six months old) providing she doesn't smoke cigareets [sic] before she's 21 years old." [Laughter]

There's still one more facet of this story. Years later, Johnny Henle was finally persuaded to sell his fifty-two acres to the University of California, and in the sale he gave them everything -- the tractor and the almond hauler and all the rest of it. He had no use for it. This was the end of his

Bainer: farming career. Some brass came up from Berkeley to talk to him and they were looking over the equipment. We had a farm superintendent here by the name of Henry Sevier that was with them, and Ira Smith, controller, from the University here. Here was this group out there and they were talking, and finally John Henle piped up and said, "I want to tell you gentlemen, if you ever have any trouble with this tractor, you have a man over in ag engineering that can get it going in just fifteen minutes." [Laughter] And did they get a kick out of this, especially this farm superintendent whom I knew quite well. [Laughter]

Dickman: Now to return to the main story; you took special examinations to advance your college program?

Bainer: I remember that I finally got up to the junior year, in college, and had the privilege of taking course by special examination. So I figured, by golly, I shouldn't have to take the courses in gas engine and tractors. I went over to see the instructor and asked if I could take them by special examination for credit. I took two courses that way for credit. Well that gave me six units that put me ahead in my program.

Dickman: What was the other course?

Bainer: There were two courses, one was gas engines and the other was tractors and trucks.

In my senior year I had these six units available, and there wasn't any formality to taking graduate work if you had completed your undergraduate work, so I took six units of graduate work in my senior year.

GRADUATE WORK: RESEARCH AND FIRST ACADEMIC JOB

Bainer: I also had two other rather interesting experiences. All the while I was in college, I worked for ag engineering in the shop. My senior year they were short an instructor, to give a two-month course to the farmer short course students, in tractors, and they approached me and asked if I'd teach it. I said, "Well, I'll be glad to," and here I was, five years later teaching the same gol darn thing I had five years before. [Laughter] I remember, they paid me 50 cents an hour for teaching this course.

Bainer: That wasn't exactly right, (they thought that was a little rough) so they gave me 50 cents for an hour for preparation, (they knew I'd have to prepare) and then they gave me 50 cents an hour for the time I was in the class, and another 50 cents an hour for grading papers, so it totaled a dollar and a half an hour.

The money didn't mean anything to me. I never was interested in the money end of the thing -- just the experience and the fun I got out of it.

Dickman: Talking about money, though, you'd put yourself through?

Bainer: Oh yes, and I even bought a hundred acres of land while I was going to college and paid cash for it. I always had planned on going back to the farm. I had never thought about anything else.

During my last semester, Professor Walker, who came to California later, (I was taking his course in farm structures) started working on me to stay on another year. He said, "You know, W. H. (Cap) Sanders (who'd been a member of the department for years) wants to take a years leave (we didn't even have sabbatical leaves at that time, you just took a year and went off)." Cap had made a little money on some land that he had received in partial payment for a job that he did in Florida many years before. He was the captain of a dredge boat on Lake Okeechobee and they didn't have enough money to pay him, so they paid him in land. During the boom -- the early '20s -- do you remember when they had the big land boom in Florida?

Dickman: Oh, sure, I've read about it.

Bainer: He sold that land for a fabulous price, but unfortunately, he only got a fourth of it down, but the fourth that he got in cash, was ten times more than the land was worth. So he did all right. He still had the land, you see. Well, he wanted to take a year's leave of absence, so Walker started on me, and he said, "We'd like to have you stay around here another year, and we'll offer you an opportunity to take some graduate work, you can take five units a semester, so you'll have ten units of graduate work behind you for a master's degree. You already have six." It took thirty-two units for an M.S.

Dickman: You'd have half of it.

Bainer: I'd have half of it. I couldn't make up my mind if I wanted to do this or not. And, of course, I was engaged to be married and we'd set the date in the meantime. We were going to get

Bainer: married during senior week, and then my wife was going back to college and participate in all the senior activities, which were quite elaborate in those days.

I wrote to her, and she discussed it with her parents, and I discussed it with mine. Everybody but me thought this was great, that my alma mater was offering me a job, even though it was only temporary. I couldn't make up my mind. I just couldn't make up my mind. I had thought that if I took a job away from the farm, I would go with one of the implement companies. I figured that might not be too bad, to go with John Deere or International Harvester.

But, I had this vested interest here. So, finally it got toward the end of the semester and I got an offer from J. B. Davidson at Iowa State College, where my father had gone. They offered me a position up there, and it was more money than Kansas was offering, but again, the money wasn't a factor.

Then I got an offer from Minnesota. Ag engineers were scarce in those days, Kansas State had offered me $1,800 a year for eleven months, and that was the going rate. I think Ames offered me $2,000, and Minnesota offered me $2200. I wasn't really comparing or jockeying for positions, I was trying to decide if I really wanted to do this sort of thing. I knew I didn't want to go to Minnesota. It was too cold. I wasn't too enthusiastic about going to Ames, for some reason. I knew if I did anything I'd stay at K. State. So it finally came to a show down, and Walker said, "I'll give you 'til one week from today, and you're going to say yes or no, because I've got to get somebody, and you've stalled this thing long enough."

So, when he came in the next week he said, "Well, are you going to take it?" And I said, "Yes." [Laughter] So, in 1926, after receiving my Bachelor's Degree, I took a temporary position and started working on a Master's program. Later on of course, I had to select a thesis problem, and I talked to different persons, including Fitch, who was the head of the dairy department. He had hoped that someone would make a complete study of dairy barn floors. This may seem an odd sort of a program but remember we were in a climate that got down to zero or below, and dairy barns were used to quite an extent. Fitch had installed various floor materials. Everything from just plain concrete to concrete over hollow tile, asphalt, cork, wood blocks, etc.

Dickman: Was this done for research purposes?

Bainer: Yes, they were put in, but no one had ever made the study. I was persuaded to make the study with two primary objectives; one, the comfort of the cow, and the second, the maintenance and ability to keep them clean.

I installed thermocouples in the surface of these floors to measure the temperature of the floors. It was a twenty-four hour deal. So I hired a couple of other students, and the three of us worked in shifts on these floors, and we observed everything. I mean, the behaviour of the animals, the amount of time they were down and up, and the temperatures that developed under these cows in these different floor materials, and plotted all of the data. And it was accepted as a Master's thesis, and was published in Agricultural Engineering, eventually.

It was kind of an interesting study in that you could correlate the floor materials with the amount of time that the animals actually laid on them. They laid down, and if it didn't warm up they'd get up. The temperature in the wood block and cork floors would just skyrocket under a cow, and the concrete would carry the heat away from them. So maybe it was worthwhile, I don't know.

Dickman: Has there been any change in barn structures -- most of them are still using cement?

Bainer: Of course out here in California, we don't keep animals in barns. Back in that area, they use concrete because of the cost and ease of keeping them clean. But, nevertheless, this was something that people wanted to know about, and we gave them an answer.

Dickman: That was a good thesis. Then you went on to do other research while you were an instructor?

Bainer: The first job that I had at Kansas State was a cooperative study between the United States Department of Agriculture, Oklahoma Agricultural College, and Kansas State Agricultural College, involving both agricultural engineers and economists. We made a study of the possibilities of using the combine harvester for harvesting grain sorghums in southwest Kansas and western Oklahoma. What had happened was that in 1926, there was a big influx of combine harvesters into the winter wheat belt, which Kansas is right in the heart of. There were 8,000 combines sold in Kansas in 1926, and immediately people wanted to know whether these combines could be used for purposes other than harvesting wheat. A team made up of a couple of people from Washington, two from Oklahoma, and two from Kansas made a study of combines in grain sorghums. We headquartered at Liberal, Kansas, in the

Bainer: southwest corner of the state. And as we began to talk to dealers and farmers, there didn't seem to be anyone who was going to try the combine. Maybe the use of the combine was going to be so small for grain sorghums that you couldn't justify all these people out there, making this study.

I had written to one of the branch houses in Kansas City, and received a list of farmers who had inquired about the possibility of using combines for grain sorghums. They were around Pratt, which was a hundred and fifty miles east of where we were. So I told the other fellows that before we called a halt on this project, why didn't they let me take a quick trip up there, and at least contact a few of these leads that I had. I found a lot of interest, and before we were through we really had all we could do. People were just slow getting into it, but it proved one thing to me, that the combine was going to be more of a universal tool than we ever had thought it might be. But the problems were just almost insurmountable because these grain sorghums were so erratic in their growth. We had grain sorghums from three to twelve feet high. Some were known as straight neck varieties, others crookneck varieties. The latter would catch on the reel slats of the combine, until it was built up solid. It was very evident that the combine could handle and actually thresh this material, but there'd probably be a problem of storage because the sorghums carried a high moisture content at the time they're harvested.

So I was then appointed as a collaborator to the USDA, and every two or three weeks I made a trip back to this area where these grain sorghums that had been combined were stored. We had buried little sacks of grain sorghum in the bin so we could pull out a sack and get a sample. We also had a sampling tube for sampling the grain all winter. Everything went along fine until it started warming up in the spring, and the sorghum started to heat. We had to really get that sorghum out. The farmers didn't realize the temperatures that were being reached in those bins. We had a thermometer probe to get right down into the heart of the bin and get the temperatures. When they saw these samples start to heat up they started moving sorghum.

Dickman: Did you ever write that part of it up?

Bainer: The results were given in a USDA Bulletin. A couple of years later, 1928, I knew that plant breeders were working on a uniform type sorghum plant that could be combined.

Dickman: How did you know that?

Bainer: Just reading about it. The plant breeder at Manhattan, Dr. John Parker, called me one day. He knew I had been working with grain sorghums, and asked me if I had time to go out and take a look at a sorghum field. I said, "Sure, I'll go." So he drove me out to the country and we came up to the most beautiful sight I've ever seen as far as grain sorghum is concerned. Here was a field of grain sorghums that was uniform in height. The plants were just about desk high and absolutely even throughout the field. And he said, "Do you think that would help with grain sorghum harvest?" I said, "you've got the answer."

That was my first experience as to what a plant breeder could do toward preparing a plant -- or changing the characteristics of the plant -- to meet a situation much as mechanical harvest with the combine. And it just revolutionized the grain sorghum industry. Well, this work was done jointly between the Oklahoma Agricultural College, the USDA, which had a station at Woodward, Oklahoma, and the Kansas group. They were all working toward the same end. Of course we did publish our results of the grain sorghum harvesting. That was published, actually, as a USDA publication. I was listed as collaborator. But we pointed out the difficulties of non-uniformity affecting the harvest. So, when you go out now and see a nice level field of grain sorghum in the fall (and you see them all over California) that's the result of a plant breeder that met the situation and came up with a different character plant that could be combined.

These sorghums still carried a high moisture content, but in the meantime we had learned more about drying grain and the equipment that was developed for rice drying was adapted to drying grain sorghums. So there's no problem any more. That crop became mechanized rather early.

The other work that I was involved in at Kansas was in our CREA program. The Committee on Relationship of Electricity to Agriculture supported some research work. We had a demonstration farm set out at Larned, Kansas, and also did quite a little work in Manhattan. The last year I was at K. State, I had a project at the Hays station, which was about 250 miles west of Manhattan, in the use of electricity for filling silos and preparing feed for animals.

This was quite an interesting experience. I remember going out there and getting ready for the fall work. Silos had always been filled with cutters of the flywheel type. They would elevate the silage into a 60 foot silo. They were

Bainer: powered by tractors. For example, the machine that was at Hays had a sixteen inch throat and was capable of cutting and elevating from 15 to 20 tons of material per hour, but it took sixty horsepower to run it. One of the things that I had learned when I was in school was that there had been some work done on ensilage cutters in Wisconsin. Floyd Duffee had simply applied known laws of moving air, and had determined that one reason for the great consumption of power was that the speeds were improper. The power varied as the cube of the speed.

Well, the idea was that we would try to use electric motors to run these cutters, and about ten horse power was as much as the lines would carry. We decided that we'd use a ten horsepower motor. We were striving for a ton per horsepower hour. That would be ten tons an hour. If we could put up ten tons an hour with an electric motor, it would demonstrate that this was feasible. So, we made arrangements with four manufacturers of ensilage cutters for the loan of machines for the trials.

Three of the cutters arrived right on schedule, and we set them up and installed the right sized pulleys. I'd calculated the speeds these had to run in order to reach the top of a silo. But the fourth machine didn't show.

Some young fellows that were working there were assigned to help me unload and set up the cutters. Pretty soon I got to be kind of the brunt of a lot of jokes, -- just plain kidding. These guys said, "What are you going to run these cutters with?" I said, "Well, you saw that ten horsepower electric motor that we have." "Ho-Ho," they said, "did you see that other cutter down there?"

I said, "Yes, I've seen it. Do you know how much horsepower it takes to run that machine?" They said, "We can even clog it up when we've got 60 horsepower driving it." They didn't think it would be possible to run it with a 10 hp motor. They were giving me a bad time. Well, I wasn't too sure, you know, but I'd done some calculations. Well, we finally got around to what we were going to fill in for the fourth machine that didn't arrive. I said, "Well, let's pull up the old cutter that you fellows have been running." I'd already done some measurements of pulleys, and I knew that they were running it twice too fast. I also knew that the power required to run these blowers went up as the cube of the speed, so if you doubled the speed of the cutter it took eight times as much horsepower to run it. And I was surprised that they got anything through at the speed they were running it.

Bainer: I didn't tell these fellows that. That was just my ace in the hole. So I said, "We'll just take that old cutter that you fellows have been using. It's put up about 1600 tons of silage. We will sharpen up the knives and ledger plates and adjust the fan housing (I didn't say we were going to change pulleys) and we'll put that in the line. Then they knew I was a screwball.

It finally came time to start the test -- it was about quitting time, but we were all set up, and the superintendent had several loads of silage material to chop into the silo. I told the superintendent to "put the spokesman for all the other guys on the wagon and let him feed the machine." I'll never forget that guy getting on the wagon and putting his two thumbs under his suspenders, and bowing to everybody. I turned the switch on, and I said, "I don't want any delay in getting this material into the machine. I want an overlap of bundles of about a third." I figured I had to do this to get capacity. I had him jump off of one wagon and onto another. At the end of an hour we had put up eleven tons of silage!

Well sir, we decided we'd quit then for the night, and he came down and just whispered, "What did you do to it?" It was just the funniest thing! Well I didn't tell them for a while. I just let them ponder over this thing, and finally explained to them that it had been run at an improper speed. I said, "You know, the law governing centrifugal machines such as blowers and pumps states that if you double the speed, you can elevate twice the amount of material four times as far. In other words, the head against which you operate varies with the square of the speed, so that would be four times; the power required goes up eight times, 'cause you're pumping two times of material against four times the head, and two times four is eight times the power. It's just as simple as that.

Well, boy, I sure made some converts out of that operation. Finally another funny thing happened. A field man for one of the cutter manufacturers came out, and attached a tachometer to the shaft of his company's machine and said, "Boy, you're just running this about half as fast as it ought to be run." He says, "It's painted right on there: 600 revolutions a minute. You're only running it at 295." I said, "Well, I know," and I tried to explain why to him. He wasn't going to listen to any explanation. He said, "You're going to run this at recommended speed or I will pull it off the line." I said, "OK." So I just changed the pulley to operate at 600 rpm, and you couldn't even run it. Boy, if he didn't get a lesson that

Bainer: day. So as I say, what little knowledge I had was much more than the rest of them -- knowing a few fundamentals and applying them. It was a very interesting experience.

Then, of course, we had other projects. Every two weeks throughout the winter I went out there to study machinery and prepare feed for the feeding trials.

Dickman: This was published under the title "Beef Cattle Investigations of 1928-1929"[17th Annual Cattleman's Round-up, Kansas Agricultural Experiment Station, APR. 1929].

Bainer: That's right. It was a very, very interesting experience. It just about took the whole winter because I was involved out there so much, and then we were analyzing our samples. We had to run moistures and make screen analyses. That was the last project that I worked on at Kansas State.

There were two other studies that I was partially involved in, and both of them terminated in publications. One of them was on "Wiring the Farmstead," [Kansas State Extension Service Bulletin 63, May 1929] and the other was"Electrical Cooking in the Farm Home " [Kansas State Extension Service Bulletin 66, May 1930].

I mentioned that we had this demonstration operation at Larned. There was a power company out there very active in promoting use of electricity in rural areas, and that's the reason we centered there. We had a man out there by the name of H. S. Hinrichs. He rode herd for about four or five years on these farms studying the use of electricity for everything you can imagine; from pumping water, feed preparation, refrigeration, cooking, lighting, farm chores, milking cows, etc.

Well, we didn't have that sort of information in the '20s. I became involved in the studies and analyzed all of his samples that were sent into headquarters at Manhattan. He didn't have any facilities for running the moistures or screening analysis in the field. And then it was suggested that we get out some publications. Hinrichs left and went with Kansas Power Company in Topeka, and that kind of left us in the hole. And we had to gather the background from the information that had been collected.

When we got into electrical wiring and cooking we brought in L. M. Jorgenson, who was in electrical engineering. But this was all based on studies that were made by the Larned experimental group. Those two publications, I think, came out about the time I came out here.

Dickman: What teaching did you do when you were an instructor at Kansas State?

Bainer: I really did very little teaching, mainly substitute teaching. I didn't have any regular classes. Even though I had a teaching title of instructor, I only took over classes when somebody was going to be absent or was sick.

PROMOTION TO ASSISTANT PROFESSOR

Bainer: In January, 1927, Walker came to my office and said, "Do you know Verne Hillman is taking a position at Virginia Polytechnic Institute (VPI), you've had six months now to sample this sort of work, and would you be interested in taking Verne's place?"

And I said, "I think I would, after I talk it over with my wife." We decided we kind of liked the college influence and living in a college town, and having [laughter] respectability, and so forth, so I said, "Yes, I think I'd be glad to continue on for a while." I could always go back to the farm if I wanted to. And so that was my first promotion. I was an instructor the first year. They made me an assistant professor and assistant ag engineer in the experiment station, with a raise in salary. I was getting $166.67 a month, for my first job, and this raised me two hundred dollars a month.

Dickman: Now, is this when you did your research on that sod house?

Bainer: Yes, though it was supposed to be pisé de terre, which was rammed earth. I had to do a thesis for my senior year. Not only did we do a thesis for a masters, we also did a thesis for a bachelor's degree in Kansas , so I selected pisé de terre (rammed earth).

See, there'd been some houses built way back in the 1700s in Florida, called pisé de terre. For my BS thesis I made specimens, by ramming dirt into cylinders that were two inches in diameter and four inches long. They were tested for compressive strength periodically over a period of six months. They became stronger and stronger with time.

It was just an interesting laboratory exercise with the idea that maybe somebody some day would do this pisé de terre job.

When I joined the staff, Walker thought, maybe we ought to continue this project. So I played with it a little further and

Bainer: I said, "You know, there are ways of doing this that are a lot easier than ramming earth, and that is to make adobe blocks." So I started molding adobe blocks. They were two by four by eight inches. We put straw in some of them, as a binder, and we put bitumuls in others to repel water. I made a lot of these bricks and I tested them, and it finally got to the point where I built a 9' x 12' house out of adobe with a stucco exterior and a plaster interior. We studied this house over a period. I've always regretted that the house was put in the wrong place, and after I left there, of course, it was going to be right in the middle of a road, so it had to come down. But I got a lot of data on that house, and while I didn't do any thesis work on that afterwards I still had that experience of building an adobe house.

BACKGROUND OF MY WIFE, LENA

Dickman: At the time, did you know that your wife was born in a sod house?

Bainer: Yes, I did, because she went to college in Manhattan for a while, and then she went to Hays Normal School, and taught for a couple of years before we married.

Dickman: Since we are talking about her now lets continue -- Where was she when you met?

Bainer: Scott City, Kansas.

Dickman: And how long did you go together before you married?

Bainer: Well, we were engaged in September, 1922, and got married in 1926. I didn't want the responsibility for a wife when I went to college, you know, because I didn't think I had that kind of money. And no one was married in those days. Oh, we did have one guy in engineering that was married. My future wife and I just decided that the time to get married was when I finished my education and we held to that. She taught school -- fourth grade -- in Scott City while I went to college. And, of course I spent my summers out there working on the farm and saw her regularly.

Dickman: Had she grown up on a farm?

Bainer: She was born in a sod house in eastern Scott County, on a claim, actually. Her parents came with their parents to western Kansas

Bainer: when they opened up the land for homesteading. There were several families from around Kalamazoo, Michigan, who knew each other. They came out there and homesteaded, and after about three years, gave up. You know, farming in western Kansas as compared to Michigan was such a contrast that they couldn't adapt to it. My wife's father, who was just a young man, around 16 or 18 years old, and the mother, just about the same age, and they were looking at each other, I guess [laughter] (there wasn't much courtship in those days, they didn't even have a buggy.) They just entertained each other at family dinners, barn dances and so forth. When the decision was made that this whole group was going back to Michigan, my wife's father said, "I'm going to stay right here and settle up on this 160 acres of land." So, when he said that, her mother, who was in another family, said, "I think I'm going to stay with him and we're going to get married and settle up on these claims."

So the two of them stayed there and got married at a very early age, and in about three or four years they owned 320 acres of adjoining land. The only materials that they had to build with in those days was sod. You went out with a plow and a team, and you just simply plowed up sod in the spring at a depth of a couple of inches, and rolled it up and hauled to the building site. A foundation was laid and a wall of sod was made with framed openings for windows and doors. Lumber was used for the roof and floors. They put sod on the roof to shed water. Some houses had only a dirt floor.

Cool houses -- they were cool in the summer, you know, and they were warm in the winter. They had very few windows. So all four of the children in this Cook family that I married into, were born in that sod house, including my future wife, Lena.

Oh, it was pretty rugged. She had a much more rugged time than I did in growing up. Finally her family moved to town -- but kept the farm going. Her father got interested in a county office and became an undersheriff and then sheriff -- a sheriff couldn't succeed himself, after four years he had to leave office, but I think he was sheriff three different times for the county. Then he ran for the state legislature, was the Representative from the county. He kind of got in politics and got away from the farm.

Dickman: She has three?--

Bainer: Two brothers and one sister.

MOVE TO UNIVERSITY OF CALIFORNIA, DAVIS

Bainer: My father who -- up to a certain point, was very influential and helped me, but I would say that the one man who did more for my life was H. B. Walker. He came to California in 1928, and I'd been his student and on his staff at Kansas State for two years. Only one year working under him, because in '27-'28, he took a leave and did a special job for the USDA. Not on a sabbatical, just on a leave without pay. When he came back, California beckoned him. Apparently E. J. Stirniman who was acting head here, told the administration that there was only one top agricultural engineer in the country, and that was H. B. Walker.

So they brought him out to California in '28. That summer the ASAE, American Society of Agricultural Engineers annual meeting was held in Washington. Walker knew that my wife and I were going to the meeting. During this meeting, Walker said, "I'm going to California, you know. I have found out that I have about four or five positions open out there. Would you like to come with me?"

After talking it over with my wife, I said, "Yes, I'd like to consider it." When he arrived in California he found that the position he had in mind for me was an associate in (a non-academic position) agricultural engineering, rather than an assistant professorship. So, he said, "I offered this position to you, and it is still open, but I'm going to advise you not to take it."

So I stayed on at Kansas. In January (1929), Walker had another resignation which opened an assistant professorship. He offered this job to me. That was the second time, you see. And I just turned it down flat. I said, "Well, things seem to be going along pretty well here. I'll just stay."

By April I knew I wasn't going to stay because Walker's successor just didn't fit. Walker offered me a third position in April, and I remember my office mate was R. H. Driftmier, who should have had Walkers job at K. State. He said, "Walker probably isn't going to offer you any more positions. After all, this is the third in a year. If you're thinking about going, this is the place for you to go." So, I wrote to Walker and told him I'd take it.

Bainer: Then Walker talked with Dr. W. L. Howard, who was then the director [and Associate Dean, College of Agriculture] and told him that he had hired me, but that I still lacked just a little bit toward finishing up my Master's Degree. If I could have one month leave I could finish my M.S. degree. Howard said, "By all means." So I got paid for one month before I ever came to the University of California. When I came, the check for July was on my desk, and it came in handy!

Dickman: What was thought at that time of a Ph.D.?

Bainer: Oh, no one got one. A very few even got a Master's Degree. Of course after I got here I felt the need for more education so in 1937 I went to Stanford to investigate the possibility of studying for an engineering degree. It wasn't a Ph.D., but it bordered on a doctor of engineering. Stanford agreed to accept my Master's Degree, and that would cut the time required for the engineer's degree in half. I had applied for a sabbatical, and I thought I would go to Stanford and get this degree.

I was just about ready to close up everything when Walker received a grant from the U.S. Beet Sugar Association. It was for eighty thousand dollars for research on mechanization of the sugar beet production. So he called me in his office and said, "I know this is going to be a disappointment, but I just want to tell you that we'd like you to forego your privilege of a sabbatical for four years and take over this project." Well, what could I do?

In four years we were in the War, and then we couldn't get a sabbatical. By then I was already a professor and was farther away from an academic program, so I never got a Ph.D. But I never felt that the University ever held me back because of my lack of degrees. I think the University is very fair in that they recognize accomplishment, and you move as fast as you're capable of going. So it has been a wonderful institution to work for.

When I announced to my father that I was leaving our alma mater - you see, it was his alma mater, too -- to take a job at Davis, he told me that I was out of my head. He had been in Davis in 1915, and that's a long time before, and he said, "There's nothing there." And he was just about right. He just had a fit! He said, "You should have gone out there and looked the place over." And he really gave me a bad time. Dean L.E. Call and my father had been very close together for years. They

Bainer: worked together on these special trains and a lot of other things. Dean Call called me up, when he found out I was going to Davis, and asked me to come to his office. And, did he light into me! He said, "I can't think of anybody leaving these cloistered halls here and taking a job in a place like that! Whoever heard of anything good that came out of Davis?" He said, "I'll tell you one thing, if you go out there and stay more than two years, you'll be lost to the world. Nobody will ever hear of you again !" He hinted Davis was a little town like Ogden just outside of Manhattan. I thought, maybe I had really goofed. My new boss, who had taken Walker's place, had been here one hot afternoon. He said, "It is really scorching. You're really going to suffer," and he'd only been here for two or three hours. But there was another fellow by the name of J. B. Fitch, who was head of the dairy department. I did my thesis on dairy barn floors under him for my Master's. When I went in to bid him goodbye, I said, "Well, it sounds like I'm going to the end of the earth."

He said, "End of the earth, what are you talking about?" "Well," I said, "everybody tells me what a fool I am to give up this nice locality, and move to a place like Davis, California." "Why," he says, "it's ridiculous." I said, "What do you know about Davis?" He said, "Well, I go out there and judge the State fair about every third year, and I go over to Davis, and I talk to the people." He said, "There's not very much there now, but one of these days it's going to be a great institution, one of the greatest in the country." He said, "They'd better not offer me a job." And afterwards he left and went to Minnesota to head the department. That was the only encouragement I got about coming here. I told my dad: "I've got great faith and confidence in H. B. Walker, and I don't think he would have made two mistakes -- he went there, and then asking me to come to a place that just wasn't ever going to amount to anything. Furthermore, if you look at the literature in agricultural engineering, the best literature that's been published during the last five years came out of Davis."

Well, I came out, and we had the new building. Walker Hall was up when I came. They had the old classroom building which was where the library is now. They had horticulture which was torn down last year. And Roadhouse Hall, which is destined to be demolished and the Animal Husbandry building, and that's all. They had some frame buildings around. There were no paved roads on the campus. The quad was in alfalfa.

Dickman: This was in '29.

Bainer: 1929. Well, I soon found out that I really came into one of the greatest opportunities that a man can ever have in my field. My father came here to visit us periodically, at least once a year -- and the more he came, the more he became attracted to Davis. He finally apologized to me. He said, "You know, you're the one who was smart and I was the one who was dumb." So my dad and my brother were my two best press agents and my mother too. Of course, I had plenty of opportunities to leave Davis, but I never could make myself do it.

Dickman: Why did Harry Walker come out here in the first place? What motivated him?

Bainer: Opportunity. Ag engineering was a relatively new profession in those days, and Davis, in his estimation, had the greatest potential. In the first place, it had good physical facilities, and the State of California offered more challenge to an ag engineer than any other state in the union.

Dickman: And what was his first position here?

Bainer: He came here as chairman of the department, full professor and chairman. He got a pretty good increase in salary. [laughter] I expect that had a little bit to do with it.

Dickman: What was your starting salary?

Bainer: I got $3,000 a year when I came here.

Dickman: That was a big increase.

Bainer: It was a pretty good increase, but I sure went a long way from there before I retired.

Dickman: Where did you live when you first came here?

Bainer: I lived on a farm, across the railroad track from Solano Park.

Dickman: You were renting?

Bainer: Yes, I rented. Walker got this place. You know, there weren't any places to live in this town. Davis was just hard up for housing.

Dickman: And now still.

Bainer: Yes, but it was worse then. Everytime somebody moved there would be at least four moves, because everybody would move up, you see. There were two places available, the home on this farm, which, as

Bainer: I say was across the track from Solano Park. It was a nice house, had city water and power, and five bedrooms. The people who were in it (E. L. Overholser) were going to be away for six months. He was going to the Orient with a boat load of dried fruit. They were trying to find out if there was a market for dried fruit in the Orient. He was Ass't. Prof. of Pomology and she was going to spend the six months with her folks back in Missouri. So here was a furnished house available for six months. There was an apartment which was where the Diogenes house is now, an upstairs apartment was available, and Walker had lived in that one year. (He had built a house, in College Park.) So he said, "Well, there's just these two choices." There was a house for sale here, but I didn't want to buy something sight unseen. So, I told him "Rent this place at the edge of town." Well, we paid $45 a month for the house and the use of the furniture, and when Overholser came back from the Orient, he took another job at Washington State College.

The man (Theodore Oeste) who owned the house came and asked me if I'd like to rent it. He wanted to keep the house separate from the people renting the land. So, he offered it to me for $35 a month (unfurnished). So we had to buy furniture. That was the first furniture we bought. We lived there 25 years.

Dickman: When was La Nelle, your daughter, born?

Bainer: In '34.

Dickman: So that was just five years after you got here.

Bainer: Yes. you wouldn't believe the rental deal on that house. You'll understand why we lived there, and I'd be better off financially if we lived there today. [Laughter]

It was an interesting thing about this landlord that I had: He was a bachelor and lived with a bachelor brother and a maiden sister. They were very wealthy people. After I had lived in this house for a while I noticed that he wasn't cashing the rent checks regularly. He would let the rent checks accumulate as much as twelve months, and he seemed either to dump them in the bank prior to the first of January or just after January, and I figured that would depend on how much money he was going to have to pay taxes on. Of course, the bank always told me that they should have notified me that he was dumping twelve months checks in the bank at one time, but knew that I had the money in there and had written the checks and would probably OK them.

Bainer: This went along for a couple of years and finally one day I met him in front of the Post Office. I said, "If you're going to cash those rent checks just once a year, why don't I send you a rent check once a year? It would simplify my bookkeeping."

"Well," he said, "suppose you send them every six months." So I waited six months, sent him a rent check, waited another six months and set him another check. He still held the rent check for December of the year before, and he didn't cash either one of these six month checks, so I told my wife, I wasn't going to send him another check until he cashed the ones he had. Well, I let it go a whole year and he never said a word. At the end of the year I sent him a check for the whole year. He didn't cash that one either.

Well, I found out that he was in about the 80 percent income tax bracket, and wasn't getting much out of that $35. So, I told him "I'm not going to send you anymore checks until you cash the ones you have, and I'll buy a $50 bond every month, and when you need the money, you let me know and you can have it."

So, I started buying a $50 bond as a hedge against the time when he'd cash the checks. And this went on and on and finally he died. I didn't do a thing, there was no settlement or anything. It was at least ten years that I had use of his money, and of course, by the end of ten years it appreciated by about a third, and finally, oh -- it was ten or twelve years later, his sister called, and said she was in financial difficulty because the other brother had gotten in trouble with the government during the war. They owned a brewery up in the country and they had used illegal barley in making beer.

She was in difficulty, so she called me that one day and asked me if I'd come out to see her. I went out and she said, "I really need some money. My brother was always very lenient and very kind to people. You've benefited from his generosity," and so on and so on.

Well, in the meantime, we didn't let the house go down. I told my wife, we ought to have it painted once in a while. We had interior decoration done. And I had, oh, eight or nine hundred dollars in bills against the house. I realized that I was getting this thing on pretty good terms, but in order to maintain it and make it liveable I had done this work. I gave her the receipts, and she said, "Just deduct it." So, I never did pay them the interest that I got on that money for ten years. So,

Bainer: finally she died. There were no close heirs, just a nephew that inherited the place. The first thing that he did was to come out and raise the rent to $65 a month which still was reasonable because it was a four or five bedroom house. We had bought lots in new developments in Davis. We owned property on Oak Avenue and Miller Drive, with the idea that someday we would build in town.

The whole deal was the fact that now our rent had been upped, but was still reasonable, but we decided to build a house on Miller Drive. In 1956 we built the house we now live in. I was a lot better off financially renting the other house, I'll tell you. That guy really didn't have any use for money. It was a very odd situation.

Dickman: Let's talk about your early days at Davis, in Ag. Engineering.

Bainer: I appeared on the scene in August 1929, after receiving my Master's Degree at Kansas. I was told that I was to be an understudy in the fall of Professor E. J. Stirniman, [Assoc. Prof. Agr. Engineering], who was responsible for teaching the courses 104 and 114 in farm machinery. In the spring, I would be responsible to Professor Ben Moses [Assoc. Prof. Ag. Engineering], who taught two courses in farm power: tractors and gas engines.

So I started out in the fall as an auditor, for the lectures given by Stirniman, and handled three laboratories per week. We had a research project that Stirniman had just started -- a research effort to study the use of the combine harvester in rice. He was going to follow what was known as the windrow-pickup method. The rice was cut with a 12 foot swather and deposited in a three foot windrow on top of the stubble to give circulation of air around it. After three or four days in the windrow, it was picked up by a combine and threshed. In that three or four day period the moisture content would decrease to a safe storage point.

Well, we had to spend days and days in the field. The work was done at the River Farms, which is northwest of Knights Landing, California. Along about the end of November, (we were through with the field work) Stirniman went to Russia on their five year agricultural plan to show them how to use machinery. The first thing I knew, Mr. Stirniman had gone, and I was in charge of the class. I gave the lectures during the last month of school. This gave me additional responsibility so I never got to be an understudy of Ben Moses in the spring.

Bainer: Stirniman was in Russia three or four years, and then he took a job with Caterpillar and stayed with them the rest of his working life. His job was to make sure that Caterpillar was fulfilling their obligations in serving people, mainly checking on dealers.

Dickman: Did you ever talk to him about his experiences in Russia?

Bainer: Yes, several times. He was the type of fellow who would get along anywhere, but he used to tell about the days when they would all be assigned under this collective arrangement. Some people would do this, and others would do that. So it wasn't very long 'til the shop group decided that they wanted to operate tractors, and vice versa. This gave Stirnie lots of head aches.

The Russians had bought Caterpillar tractors, and Holt Harvesters, (that were built down in Stockton) and they immediately started to copy them. He told me that the food was very poor, and periodically he'd go over to Germany for a good meal with his family who were living there. The project wasn't too successful. No one really knew what they were doing, you know, and they were trying to do too much in a short period without the experience that you need to operate equipment.

The last time I met Stirnie was a very interesting experience. I was down in Chile (I haven't talked about this yet, but I will get to it). We took this group of students who were in a concentrated course, in mechanization, to see a reclamation project in the Magellanes country which is just north of the Straits of Magellan. After we'd been up there for three days we came back to stay the night in a hotel in Punta Arenas. I was having dinner in the dining room, we were going to fly back to Santiago the next morning, and who walked in but E. J. Stirniman! This is far away from home -- the furthest south of any incorporated city in the world. And there he was. I ran into him the second time on the same trip when I was leaving Santiago. I got on the plane and walked down the aisle, and sat down, and who was the guy sitting in the seat next to me but Stirniman.

DEPARTMENT OF AGRICULTURAL ENGINEERING

An Early "Who's Who" of the Department

Dickman: If you will, please, talk about your Davis colleagues, departmental organization and thru the entire period including your chairmanship of the department.

Bainer: When I came here in 1929, Professor Walker, who was my major professor at Kansas, was chairman of the Department of Agricultural Engineering. He came here in 1928. He found a very wonderful group of people in the department. Several left while he was being recruited or soon afterwards. This gave him the job of recruiting some new staff. But I -- even in my limited experience at Kansas, had looked toward California as being one of the outstanding ag engineering departments in the country. Some of the material that was coming out of here was certainly far in advance of the information coming from elsewhere.[1]

Dickman: And this was in just two or three years of its birth, wasn't it?

---

[1] "Professor Walker had his professional university educational experience at Iowa State College. He was a general engineer, not an agricultural engineer, but since Iowa State was predominantly an agricultural institution -- likewise Kansas State, both of them land grant colleges -- there was an agricultural atmosphere there, let's say, and he became interested in its engineering problems. But he was a well-trained engineer and a very wise man. He saw here in California a great opportunity to use engineering skills and techniques in agriculture and, in my opinion, and I'm sure other people would share that, to build here a department of agricultural engineering of real stature and quality. So well did he do this that a few years ago when Cornell was searching for a man to revamp and rehabilitate their agricultural engineering they set as their first requirement a "Walker man."

Under Professor Walker's able leadership the department was firmly built. It has continued to grow under Professor Roy Bainer's direction. It has recently become the nucleus of the University's third College of Engineering. Thus do mighty oaks from small acorns grow -- if properly guided and nourished."

Claude B. Hutchison Oral History (Vice President of the University of California, Dean of the College of Agriculture) 1962. Willa K. Baum Interview-Editor. Regional Oral History Office, Berkeley p. 85.

Bainer: Yes; well of course they had a program in ag engineering that went clear back to 1915 when they brought Dr. J. B. Davidson, who was the head of the ag engineering department at Ames, and a man that my father was associated with way back in 1905, '06. They brought Davidson to Davis from Ames with the idea that he would build a real department of ag engineering comparable to what Iowa State had. Davidson only stayed in Davis for two years before returning to Ames. Things were pretty primitive around here I'm told, at that particular time. And so he didn't stay. But he did lay out some foundation work for ag engineering. He brought a man here by the name of L. J. Fletcher, who was a very effective organizer, and L. J. Fletcher then succeeded Davidson.

Fletcher was instrumental in bringing some key people here. Among them was Jim P. Fairbank and E. J. Stirniman, both came from Washington State College at Pullman. They were both in the department of ag engineering at Washington State. Jim was the head of the ag engineering department up there. Stirniman came first as an [agr.] extension engineer, and then when he moved over to the department of ag engineering, they brought Jim Fairbank down as an extension engineer. L. J. Fletcher continued to build this department. He brought in some young fellows from Iowa State; he being an Iowa State product. Seems like Iowa State more or less dominated the field for a while, and rightfully so, because Iowa State had probably the oldest effective program of ag engineering in the country. And he brought people in here like E. G. McKibben.

Dickman: He became one of your collaborators along with E. L. Barger and W. M. Carleton on your textbook? ("Tractors and Their Power Units" John Wiley & Sons Publisher - 1952).

Bainer: Yes, that's right. That's the same McKibben. Well, McKibben came here, and he was a bright young fellow. Now, I'm not kidding you. He did some highly considered analytical analysis of -- well, the first one that I remember reading, appeared as an article in the ASAE journal when I was a senior in college -- "The Dynamics of the Offset Disc Harrow"--[Agriculture Engineering 7: 92-96 March 1926] which was quite a revelation in disc tillage tools. Here was a harrow that would till a strip, the center of which did not coincide with the center of pull of the tractor. So you had an implement that would work underneath the branches of the trees, and the tractor stay out in the middle. No one really knew why that thing worked. In fact, some people said it couldn't work, and McKibben proceeded to make an analysis, and I mean a real beautiful analysis of this disc harrow and published it. It's still the bible so far as disc harrows are concerned.

Bainer: And later on, he did a whole series of articles on tractor stability, the dynamics of the wheel-type tractor. And these were published in Ag Engineering [seven articles published Jan. to July 1927]. I suppose he was one of the first fellows who intentionally turned tractors upside down and determined under what conditions tractors would flop over. You know we were having deaths in the fields with certain tractors under certain conditions. They'd just rear up and fall over on the driver. They now have roll bars that they put on the tractors to protect the operator. McKibben analyzed this thing and did a very, very effective job. And this is also the bible for the tractor designer, because he did all the graphical analysis of why these tractors turned over and under what conditions they turn over. And so, you see, having people like McKibben in here --

Dickman: How long did he stay?

Bainer: He stayed until Walker came. There was a little bit of a problem here at that time. You see, Walker hadn't been in ag engineering very long, at Kansas. Those that had met him had great respect for him, but the fact was, that he was an irrigation engineer for the State of Kansas, and not on the faculty. (He only came to the faculty to Kansas in 1921, when he organized the first program in ag engineering.) Seven years later he was here. In the seven years Walker had made a great reputation.

Others who were brought in here by Fletcher were J. D. Long, who was a farm structures man, and he also was an Iowa State graduate. There were fellows by the name of A. H. Hoffman, Leland Zink, Art Farrall, W. Ruden and Howard Matson. We come up now to 1928. Fletcher left, I believe, it was in the latter part of '27. He went with Caterpillar Tractor Company, and he stayed with Caterpillar until he retired as a vice-president in 1956. So he was a very successful man in industry, also.

A project that was well underway when I arrived in Davis concerned the development and installation of septic tanks for sewage disposal from rural homes. The bulletin on this subject was prepared by Belton and Fairbank.

The Extension Service, with the aid of Fairbank, put on many demonstrations covering septic tank installations throughout California.

Later, with the development of suburban housing, the use of septic tanks for sewage disposal became quite important. As a result, the State Board of Health took over the responsibility of preparing and distributing information covering their construction.

Bainer: The University farm plan service, handled by Agricultural Engineering, was an important factor in the development of production structures. Detailed working plans were developed covering buildings for milk cows, beef, swine, poultry, milking parlors, prune drying, sulphuring of fruit, farm laborers, etc. These plans were made available at nominal cost, through the County Extension offices.

The State Board of Health approved the plans before they were issued. H. Belton, J. D. Long, and later L. W. Neubauer were responsible for preparing the plans. They had the full time service of a draftsman.

There was an interim in which Stirniman was acting head of the department. And it was just the uncertainty, you see -- well, who's going to be the new chairman. In those days chairmen were pretty important, much more, I think than they are now, because it was a life-time job. In other words, a man came in and he was chairman for years. He had established himself, and he knew what it was all about.

It was finally announced, and I'm told by Stirniman, that in his recommendations to the administration for a new chairman of the department here, he said, "There's only one man in the United States." He'd met and had several talks with Professor Walker, who as I say, wasn't known by the other group. And when it was announced that Professor Walker would be coming in 1928; five of these people had outside offers and all of a sudden there was an exodus. We lost McKibben, Farrall, Matson, Zink, and Ruden, and it was just an exodus in that interchange. McKibben went in several different directions. First to Iowa State, and then to Michigan State, and later to Hawaii for the Pineapple Research Institute, and then he went to the U.S. tillage lab at Auburn, Ala, and finally he went to Washington and headed up Ag Engineering in the USDA. I used to kid him; I said, "Gene, you as a very young man, with the start that you had at Davis in the outstanding analytical work in connection with machinery, had you just stayed there, you'd probably be the greatest authority in the world. You had everything to work with, and a headstart." He said, "I've thought about that a hundred times. [laughter] And I'd be just as well off financially, too." Well, anyway, Walker came into the picture in 1928. The first thing he knew, he had to replace some people. I came in here actually in the spot that McKibben vacated.

R. L. Perry, who's retiring this year [1972], has been at Riverside the last few years as a vice chairman of the department. (We have a sub-department at Riverside from Davis). He was brought in from Oregon State to replace Art Farrall. They brought

Bainer: in Harold Lewis in the shop. (That was still when we had the two year program and we had a shop program, actually, for two year students.) He was brought in, in Ruden's place. And of course, J. D. Long stayed for a while. He left about 1935. So, when I came here, they had just hired three new men. Perry, Lewis and myself. Other staff members included Herb Belton. He had no college degree, yet he was a very effective, down to earth, structures man. He taught only non-degree courses.

Belton came here from San Francisco in 1912 in connection with building West Hall (which has been torn down). West Hall was where the student union is now. He was a carpenter, actually. He never left. You see, that two year program in those days, was pretty much a manual arts program.

Dickman: Non-degree.

Bainer: Non-degree, two years. He became involved, and he was a very effective teacher. I tell you when the old grads in the two year program came back, one fellow they always looked up was Herb Belton. He just had a way with students, and as I say, very effective. So Long and Belton handled the structures program. And they had a draftsman.

And, when I came here there was Ben Moses, a graduate from U.C. Berkeley, who was in farm power. And Ben also was the secretary to the CREA (Committee on Relationship of Electricity to Agriculture) and he ran the CREA program for maybe twenty-five or thirty years. They brought in a young engineer that just finished at Berkeley, Jim Tavernetti, as a CREA engineer in 1926. We had this grant from the outside that made it possible to hire a man or two. Tavernetti came in first as an engineer on the CREA program and eventually was absorbed in the department and somebody else took his place in CREA. Moses taught the degree work in power for ag students and for professional students in ag engineering; about the same that I did in machinery.

We had a man here by the name of Hoffman, A. H. Hoffman, who was brought in by Fletcher. Hoffman was a professor of Physics at Iowa State College when Fletcher was a student there. Both Fletcher and Walker took physics from Hoffman. Hoffman had left Iowa State and gone to the University of New Mexico. It was from there that Fletcher was able to entice him to come to Davis. This was one of the times that an effort was made to delegate a little more authority, and Fletcher designated Hoffman as director of research in ag engineering. Fletcher was somewhat inexperienced, and he thought if he could get a mature physicist, it wouldn't be

Bainer: too bad. Hoffman was a very effective man. He was of the old German type, rather brusk and had little patience, sometimes, but he did a lot of nice research work on his own. He was the man who did all of the early research work in connection with air filters.

Dickman: Air filters?

Bainer: For automotive equipment. He made a real reputation for it. He was probably one of the first men ever doing research in the institution who was able to convince the administration that when you reported tests on a piece of equipment, you ought to name it. You see, it used to be USDA (United State Dept. of Agriculture) would say A and B and C, and you never could get the key, and you never knew just exactly which was which. What actually happened was, that Hoffman made and broke air filter companies, because it wasn't long before every one accepted the results at Davis for the performance of an air cleaner. If it didn't stop the dirt, there wasn't any use putting it on your engine. And there were plenty of them that didn't stop the dirt even though they looked wonderful in theory and in design. The first real successful air filters were the oil bath type. There was a certain air circulation within the filter that carried a little oil up and then it dribbled down over and hit the filter cloth and cleaned it.

I would say that this one piece of work certainly earned Professor Hoffman his salary for the rest of his life, because he saved more engines from wear in the nation and in the world. Considering the dusty conditions in California, by putting on filters on these engines he prolonged the lives of many, many tractors.

Dickman: Is this particularly true of tractor engines?

Bainer: Particularly true -- but also of automobile engines. [laughter] I remember that I came here with an old Dodge automobile, and the first thing he did was to look under the hood to see what kind of filter I had on that darned car. When he saw it (I can't even tell you what it was) he took a screw driver, and took that damned thing off and threw it in the ash can. He said, "You ought to be ashamed of yourself." I said, "Well, it came with the car." He said, "It isn't worth a continental. I've run tests on it, and it won't even stop twenty-five percent of the dirt. What it stops is coarse dirt which probably wouldn't give you any trouble. It's the fine stuff that gets in that wears your engine out." He had a whole stock of filters, you know.

Bainer: Samples of every kind made. He went over and got I think it was a Bowden, or something like that, and put it on my car.

You know, I suppose I probably appreciated this more than the average guy, because going back to 1918 and '19, when I started farming, I started with an old Titan tractor which didn't have an effective air cleaner. I mean it was just -- when I look back on it, pathetic! It had a wad of hair-like material in a case, and the air and dust just passed through it. I remember how shocked I was when I began to lose power from this engine, and I hadn't had it six months. It was very evident. I had to drop one plow. When I started with that engine I could pull three plows, and it finally got to where I just had to drop one plow and it would only pull two. So, my dad got the field man for International Harvester in there, and he opened up that engine and there just weren't any rings left in it. What had happened was this dirt had gone in there and filled in underneath the rings, and just kept forcing them out against the cylinder wall, and the rings just wore out. When we tried to put in the new ones, he had to chisel that dirt out of the ring grooves.

Dickman: There's the importance of an air filter.

Bainer: Oh, I know it. And we put it back together and there wasn't anything available to put on it. If I had just run a pipe up fifteen feet in the air, to bring in cleaner air -- I didn't have the gumption to do that. We were just pulling in air from underneath the tractor where it was really dusty.

Well, anyway, Hoffman really did a beautiful job and published. He was an authority worldwide for air filters.

Dickman: Who were some of the other early staff members?

Bainer: We had in ag engineering, far more students in those early days that were in the two year non-degree program than we had in the degree program. We had three classes of students; the non-degree students, agriculture students, and the professional students in ag engineering. So, it took quite a few people to teach the non-degree. Belton was an example. He taught structures for non-degree. We had another man by the name of Stanley Winters, who taught power and machinery. And then the same year I came here they brought in a man named Lewis to teach farm shop. Lewis was a graduate of Mississippi State. Winters had no college degree, he didn't even have a high school diploma. He was a man who was brought in from a local ranch to work in our research laboratory. There was a flu epidemic before I came here, and the whole staff practically went down for the count and they

Bainer: were pulling people out of everyplace to help teach some of the courses. Winters was pulled out of the shop over into the tractor laboratory.

Dickman: Is this the J. S. Winters that you jointly published with on threshing lima beans and flax seed?

Bainer: Yes, J. S. Winters. J. Stanley Winters.

Well Stan Winters, as I say, was pulled out of the shop and was told, "Well, you're going to have to keep the teaching laboratory going for a couple of weeks. Stan said, "I'll help, but don't make a practice of it. The last thing that I want to do is be in contact and have responsibility for a lot of students." Well, he was one of the most effective teachers from the beginning. Stan Winters was a well-educated man, but it was all more or less self-taught and practical. He had a good head on him and he had been in a lot of situations and came out on top as far as knowing the practical side of power and machinery. He really had the darndest noggin on him I ever saw for a man, lacking real formal education. I often wondered where the guy could have gone had he had some formal education.

So, as I say, he was so effective in that laboratory, and they had a problem with illness the rest of the semester, and they never let Stan Winters go back to the shop. And pretty soon he was teaching both the courses in machinery and power. And then he needed help, and that's when they hired K. R. Frost, one of our graduates, who worked hand in hand with Stan Winters. Frost took most of the laboratories to start with, and eventually gave some of the lectures, and Stan finally got involved with farming on the outside and left the institution.

I would say that the two people who were most popular with students in the department were Stan Winters and Herb Belton. Both taught advanced courses for non-degree students. More or less of a problem type course where a student could select something special, and boy, they'd sure flock around Belton and Winters, because they had the ability to solve practical problems, and I certainly learned in later years that Winters was a terrific guy to work with. Not only did he have lots of energy and drive, but lots of good ideas. He couldn't figure the size of a shaft to transmit a certain amount of horse power, but when he came through, just by an eyeball estimate, you'd have a shaft that was big enough, it was probably too big, but nevertheless it wouldn't twist out of shape.

Bainer: That was about the staff when I came here. Let's see, Hoffman died soon afterwards, and we had to hire a substitute for him. Walker brought in a man from industry, Dr. Fred A. Brooks. He had had experience with Byron Jackson Pump Company, and Johnson Gear, mainly, I think in Berkeley. His father was a professor and head of Electrical Engineering in Illinois, so he came out of an academic family. His brother was on the faculty at Harvard, I believe. Dr. Brooks was the first real high powered scientist -- scientific type of man that the department had, much more so than Hoffman. Hoffman was a much older man, and his education was many years before Brooks'.

Brooks had received his education at Illinois and MIT. He came here with a Doctor of Science degree, and picked up the work that Hoffman was doing. He did a lot more work with air filters, and oil filters.

Research Projects of the 1930s:

Orchard Heaters

Bainer: Another subject that Hoffman was involved in was frost protection, so Brooks picked up that work. Brooks with his crew (he had several people helping him from time to time) really made a reputation in the frost protection work. He was in charge of the project. We had a serious freeze in Southern California around 1940, and it filled that whole end of the state up with smudge, and the people were really rabid. The problem was, we had not made too much progress on orchard heaters. We were still trying to work with the old smudge pot. Well, it didn't take long for Brooks in his studies to show that the smudge had little effect on protection. A lot of people had the theory that the smoke, you know, protected the tree somewhat. Brooks narrowed it down to just the heat. Well, Walker scouted around and I guess he probably was in contact with Boelter at Berkeley (Boelter was still at Berkeley), and Art Leonard was suggested. Walker went to Standard Oil, and hired him on loan from their research department. Leonard came here -- I think he was hired for a year; they released him for a year or a year and a half, to see if he could improve the combustion of heaters. He was a combustion engineer. Art Leonard did a remarkable job. He brought into being an innovation that could be attached to an existing heater, but we didn't attach it to start with. He started with a new heater. And he came up with the return stack idea, which re-circulated about fifteen percent of the inert gasses that

Bainer: were going up the heater stack, back into the bowl, to serve as a diluent to separate carbon particles so that they would burn more completely. The heater burned practically smokeless.

There were two people brought in the late '30s to help with the orchard heater work in Riverside. Professor Walker decided that we would have to do work in the citrus area, and Director [Leon D.] Batchelor of the Riverside Station invited us to come down. They built a small laboratory with sleeping quarters so that people who were working could start early in the morning and have a place to sleep without having to drive home in the wee hours of the morning.

They set up quite an extensive array of equipment, even including observation balloons that would go up to five hundred feet and pick up temperatures at various levels, and indicate wind patterns.

To help with this work, Professor Walker hired Robert A. Kepner, who had just finished his ag engineering work at Davis. He also brought in another young man by the name of Coby Lorenzen who was a graduate mechanical engineer at Berkeley, and had worked for the forestry service. These two were actually stationed at Riverside for a while and worked with Dr. Brooks. Another man who was brought in to help with some program just after the war (and this was after both Kepner and Lorenzen had been transferred back to Davis) was the German refugee, Dr. Herbert Schultz. Herb Schultz was brought to Davis as a DP from Germany by a church group. They had to have a job for this man, and they contacted me to see if there was any possibility we might have something he could fit into. I wanted to protect the department in case we got someone who really didn't fit, so I did a little research on this man, and I found out that he was never involved in the Hitler movement. He was more or less underground, he kept out of sight, that is. Then after the war he worked for the U.S. Air Force as a meteorologist. And I finally got in contact with one of the Air Force Officers in Germany and got an excellent report on this man. So, we finally decided -- (I talked with Dr. Brooks and others, and Brooks needed someone with this background) to bring him in, but only for one year. (Actually, we didn't have anything in sight beyond a year.) And he came in and went to Riverside and did a very, very good job. And that was, I suppose, about '48, or '49, when we got back into this second hitch on heaters and wind machines. And you probably know that Dr. Schultz is still on the faculty.

Dickman: He has a great sense of humor.

Bainer: Yes, he's the meteorologist on the campus, and he teaches courses in ag engineering as well as geography. He has a joint appointment. And he's been very helpful and he's done a lot of research work on his own; had some grants, and has established wind patterns in the Sacramento Valley and has been a great help to [Norman B.] Akesson and W. E. Yates.

They did have some problems in the Valley; aircraft dusting or spraying under questionable wind conditions. Herb couldn't be everyplace to measure wind etc, so our shop made up some little miniature weather stations. They were battery operated and they would record winds, temperatures, wind directions and the like, just a little sentinel out in the field. After we established a whole pattern of these, around through the Valley, the aircraft operators were far more careful about spraying or dusting, because they knew that this instrument recorded by the minute just exactly what the weather conditions were, and the stipulation had been made as to when they could broadcast the material and when they couldn't.

Los Angeles County had passed an ordinance which made it prohibitive for a heater to emit more than one gram of carbonatious material per minute, and that's pretty low. Leonard's return stack heater met that condition. We had ten thousand heaters built by American Can Co. about 1941.

The Riverside Experiment Station bought enough of them to install throughout all the citrus orchards at Riverside. Then the war came along. There were no freezes between 1940 and 1950, so there was very little reason to enforce the ordinance in Los Angeles, which was also adopted by two or three other counties, Orange County, San Bernardino County, Riverside County. Leonard developed this heater and it was made available commercially. Well, Leonard went back to industry after making this real contribution.

By 1950 we had, as you know, a great influx of population, and we also had some cold weather. Yes, it was one of the coldest winters we ever had. And they just loaded up Southern California with smudge.

Dickman: I lived there at that time and can testify!

Bainer: And I can remember mass meetings of irate citizens, "Well, can't you do something about it?" I was invited to talk to a group of these people, and by then I was chairman of the department. (I've gone ahead, but I have to complete this heater story). So I went to the junior college in San Bernardino, and here was this

Bainer: auditorium full of irate citizens after one of those cold nights. I thought, brother, I'm really in the driver's seat. We gave them this smokeless heater ten years ago.

Dickman: And the law was passed, requiring it!

Bainer: And the law was passed, but they hadn't enforced the law. They were getting ready to. I started out by telling them that the University had developed this return stack heater which was within the limitation of the ordinance. Fortunately, the Riverside Experiment Station had purchased enough of these heaters to heat the whole station. On the worst night, you could go out in the middle of the orchard with forty-five heaters burning on each acre, and look up and see the stars. This was a real demonstration, and Dr. Batchelor, Director of the Citrus Exp. Station, was so proud of his foresight to buy those heaters, even though he had to battle the administration in order to get the money to do it. But Batchelor did it, and he was just ten years ahead of everybody.

I mentioned the fact that this heater had been available for 10 years; that there had been war conditions with no available material; there had only been ten thousand of them built. I thought I told the whole story. I said, "The know-how is here, it's a matter now of making them and replacing other heaters." You know what the press said the next morning?

Dickman: No.

Bainer: The paper came out the next morning in San Bernardino, and said I'd been there and talked to those people, and that I'd admitted that the University hadn't done anything on this problem for the last ten years. That was the interpretation that they got from my story. I've never been so furious in my life, and when I'd pointed out so plainly that we were ten years ahead, you see. Well, you know what happened. They tightened up on the ordinance. And the next thing I knew, I was on the Orchard Heater Improvement Committee of the Chamber of Commerce, with monthly meetings in Los Angeles. I was the only man on that committee who was involved in doing anything about it, you see, because we had this active program.

Well, two or three things happened. They had a legislative hearing in Los Angeles, and I was invited to attend. The legislature came through and ear-marked a special appropriation of thirty thousand dollars for Davis to work on heater conversions. They had four million heaters in Southern California. None of them were return stacks. There was hopes that we could utilize some

Bainer: of these and just put a return stack on them. Well, I came home with a real assignment. The money came within a few days. I knew it was going to come. The University doesn't like to have this kind of pressure put on them, you know, to have special appropriation ear-marked for a special department to do a certain job in a certain length of time.

Well, I had a very interesting experience with this orchard heater improvement committee. It was sponsored by the Los Angeles Chamber of Commerce, but they brought in people from other areas, you see. I mean it was kind of an industry wide sort of thing. I met with them regularly. In the meantime, Brooks had reactivated the program in orchard heaters at Riverside. We had a laboratory in the orchard at Riverside. He began to get interested in wind machines. The wind machines were mounted on towers, you know, and would produce a circulation within the orchard. Very little was known until Brooks got into this picture about how much these temperature inversions amounted to.

During ordinary radiation frosts -- the night of a radiation frost was mainly just the high rate of radiation of the earth to the cold sky. Eighty percent of the frosts were of the radiation type. He showed temperature inversions in the first sixty feet of as much as twenty or thirty degrees. It would be freezing down on the ground and sixty feet in the air, it would be twenty degrees warmer. By having the big wind machines, he could bring that warm air down and circulate it through the orchard. He showed that he could put about seven and a half horse power per acre into operating wind machine -- e.g., one with seventy-five horse power motor could take care of ten acres, and take care of a radiation frost. That didn't mean that you could take care of a situation when a polar mass of cold air moved in, but the ordinary radiation frost was about eighty per-cent of the frosts. You could do it with a wind machine alone.

On nights of a different character, in which you didn't have the ceiling, he found that you could probably -- (he hadn't quite cemented this thing yet) but it was evident that with the combination of wind machines and heaters, that you could get by with a far less number of heaters. And so here I was on this Chamber of Commerce Committee, and they were putting teeth in their ordinance -- they were just going to stop the use of the old style orchard heaters.

I had to kind of act as a stabilizer in this group, because in the first place I said, "There are four million heaters in California, and you couldn't possibly replace them all in one year. There just isn't that kind of manufacturing facilities."

Bainer: My recommendation was that if an orchardist would replace a third of the heaters this year with return stack heaters, that he'd be permitted to burn the rest of them if he had to.

Dickman: Is this either replace or adapt?

Bainer: We weren't ready to adapt. We were working on that angle. I failed to mention that I brought Leonard back, because he was the man who developed that return stack heater. I brought him back with the idea of working on conversion units, and he did a nice job again. And then he stayed here until he retired. He taught in the engineering college.

Well, I knew that we had these conversion units available. I also knew what was going on behind the scenes, which they didn't know. And that was that Brooks was almost ready with the wind machine and heater combination. He needed another year to confirm some things that he was doing. He wasn't ready to say that with the wind machines and fifteen heaters per acre you can do what you used to do with forty-five heaters per acre. This was part of my strategy. I got these people to agree that we'll let a man replace fifteen, and that would then give him license to burn whatever he had to to protect his orchard as long as he replaced fifteen heaters, or that is, a third of his heaters. And they went along with this suggestion and fortunately the weather was no problem, and then in a year it was evident that he didn't have to buy any more heaters if he had a wind machine which would take care of eighty percent of the frost. With the wind machine and fifteen heaters per acre a man could take care of what he used to do with forty-five heaters.

Dickman: And is that the situation now?

Bainer: Yes, that's the situation.

There's one more facit to this return stack story that I think should be told. This return stack heater in the first place was built and sold for $3.70 each originally. And this is a remarkable piece of engineering when you consider the low quality fuel that this thing burns. It's kind of regenerative, and it cleaned up its own smoke. To put it on the market and sell it for $3.70 was remarkable. Now this was an agreement that the Citrus Association had with the manufacturer. Anything that he sold outside of the state he could sell for whatever the traffic would bear, and he sold some of these heaters in Oregon and they paid more for them. And he also sold these heaters for salamanders to heat garages and buildings under construction, and the like, and he got three times as much for those as he did as an orchard heater, but it was just what the traffic would bear.

Bainer: He did one thing that really amazed me. Now this was Scheu Mfg. Co in Ontario that built these heaters. They laid the stack on its side rather than vertical, and then encased it and put in an exhaust fan so you could pull all the products of combustion as well as air along the side of the heater stack. And then he could direct that air where he wanted it. On a construction job, where you don't want concrete to freeze before it sets, he could force this air from this heater, and get tremendous capacity with just about one horse power to blow the air.

I was coming out to Chicago on the old California Zephyr one sub-zero night and I went into the diner for dinner. There was an older couple having dinner, and then another young fellow came in and sat down at our table. It wasn't very long before this older couple made a remark that this was a beautiful train, and this was their first ride on it. They were going to California. And this man that was opposite me thanked them. He worked for the Burlington Railroad, and he was very appreciative of the remark and he talked about the train. Then it came out that he was on that train because it had come in late and turned right around and gone out almost immediately. They had three locomotives on the train and a boiler in each, to use for heating the water that kept the train warm, and one of these boilers was out. He was on the train to get that boiler in operation before they got to Omaha where it was going to be twenty degrees below zero that night. He said, "If I don't get that boiler going, you people may get a little cold in this train." And in the course of the conversation, something was mentioned that -- oh, I said, "You know, I noticed one time coming across Wyoming in the winter, that there was the City of San Francisco which had three diesel units, but there was a steam engine on the front of them pulling it." He said, "Well, that's because they never did get those early motors protected against snow, and they'd just whip up the snow and build up and short out. And so they had to pull them through that area with the steam engine. But," he said, "now we've got it all fixed up. We bring these locomotives in at the end of the run and de-ice them and dry out the cab." And I said, "What do you use, a Scheu heater?" He said, "Yes, what do you know about it?" I said, "Well, that heater was an off-shoot of an orchard heater that we developed at the University of California at Davis to eliminate smudge in the orchards." He said, "Well, it eliminated smudge in that round house, too." And they were using that Scheu heater to blow warm air right in there where it had to go to melt all the ice for inspection and dry out the cab. Here were orchard heaters being used in the round house.

Dickman: Did he do his job, did he get it fixed up?

Bainer: Oh yes, he got it fixed up. We didn't get cold.

Spray Systems

Bainer: Well, another young man that we hired back in the early '30s, I think this was about 1931, actually -- was O. C. French, Orval French, a native Kansan. He was a freshman in college when I was a senior, and we got acquainted by our contact with one another in the college band. He played the trumpet and I played the baritone horn. When he graduated he stayed on at Kansas State and got his master's degree, and then started working for a metal bin company that was providing storage -- farm storage on farms -- for wheat. Well, Orval came here in 1931, and he was to be an understudy -- the practice we had followed with others -- and he worked with me on several different problems. He was very helpful at the time that Fairbank and I were doing the spark arrester work. He didn't help us in the field, but he did help us in the tests of some of these spark arresters, and probably should have been included as an author in that bulletin. I always felt bad afterwards that the bulletin was published as Fairbank's and my project, and Orval had made some very worthwhile contributions, certainly in helping with the testing.[1]

Then Orval got interested in pest control equipment. And one of the first projects that he worked on was the use of sulphuric acid sprays for the control of broad leaf plants such as mustard, in cereals. The Stauffer Chemical Company set up the research grant in botany, and they brought a man in here by the name of Buzz Ball to work from the botanical side, and Orval was his collaborator. It was known that you could put a dilute spray of water and sulphuric acid on a field of grain, like barley. The barley leaves would shed it; it didn't bother the barley, but the broader leaf plants like mustard would absorb it and die. This was before we had some of these high powered selective herbicides like 2-4-D. One of the problems was, of course, when you mix acid and water, you've got a pretty potent material, and you shouldn't be pumping this sort of material

---

[1] J. P. Fairbank and Roy Bainer "Spark Arresters for Motorized Equipment" U.C. Agr. Ext. Bull. 577 July 1934.

Bainer: because it'll eat out the pumps. This happened after the spark arrester experience, and one day they were debating how they were going to handle this acid. They wanted to put the barrel of acid on the machine and take the acid out of the barrel without transferring through the tank on the machine. I mean, use the barrel as the tank. I said to Orval, "You know, we had pretty good luck with this venturi idea to get the carbon particles into the exhaust system under a slight pressure (which will be covered later) why don't you use a venturi or an injector type pump on this acid?" And boy, they picked this idea right up. There was a little injector (Penberthy) made out of bronze that was available commercially. It was mounted in the piping system on the pressure side of the pump. By using an oriface plate in this line they were able to pull just the right amount of acid, and mix it with the water after the pump had put the water under pressure. They used acid resisting nozzles and pipes. Well, this thing was a world beater, I'm telling you!

I think the funniest incident was, in the spring of the year while I was traveling back and forth between Davis and Berkeley (as I mentioned before, we had this class in Berkeley.) The railroad track goes through the University farm. They had strip sprayed a field of barley and mustard with this acid-water mixture along the railroad. Alternate strips were left unsprayed as checks, you see. There was a strip (sprayed) that contained only barley. The check strip along side had a mixture of mustard and barley. The mustard was in bloom (bright yellow blossom), so the results were very evident. Well, it was just comical. The conductor had noticed this absence of mustard in the alternate checks, and he took the trouble to find out what it was all about. From then on, everytime it was visible from the train, I could hear the conductor pointing out to people this marvelous experiment that the University was running where they'd sprayed this material to kill the mustard in the grain. [Laughter] That was really very good.

Well, then of course came along 2-4-D which was much safer to use and much easier to handle, and that was the end of the sulfuric acid deal.

After French worked with Buzz Ball on this acid spraying, we got interested in stationary spray plants. There had been several revivals of the idea of stationary spray plants over the years in Oregon and Washington, in the apple country where they sprayed so often. One day, Dennis Leary, a farmer near Walnut Grove along the river, came in to discuss stationary spray systems. He had a pear orchard that had been planted too close to get big spray rigs through. He had talked with Jim Fairbank

Bainer: about the possibility of putting in a stationary spray plant. So Orval, Fairbank, and I went down to the ranch and mapped the orchard and layed out a stationary spray system with the pumping plant centrally located. The pump was driven by an electric motor. The pipelines at intervals through the orchard had risers to which spray hoses could be attached. Men would work from each of several risers to avoid spraying each other. The trouble with a portable rig, everybody has to wear a raincoat because somebody's going to hit you with spray some time or other. Leary was spraying nine times a year, so he kept that spray plant going for months, it seemed. We fixed pipes with union connections, so that at intervals we could take them out and see whether or not they were corroding, or filling up with spray material. I suppose he used that spray system for maybe ten or fifteen years. And then, of course, the cost of labor got so high, and the so-called speed sprayers came along. He bought one and forgot his stationary spray. So that stationary spray rig is still there. I mean, the piping is certainly still there. He probably removed all of the risers so they didn't interfere with cultivation. But he gave up the use of the system, not because it didn't work, but because the labor cost of spraying got so high that he could put this speed sprayer in there with one man and do the work of maybe eight or ten people.

Dickman: Did the department have anything to do with the speed spray?

Bainer: Indirectly. Orval also became a cooperator with A. M. Boyce, who was an entomologist at Riverside. Al Boyce eventually became the director of the Riverside Experiment Station and Dean of the College of Agriculture before he retired. But Al Boyce was one of the leading entomologists in the state, and they had a lot of entomological problems with citrus. He learned that Orval French was devoting almost full time to pest control machinery. They worked up a cooperative project. And Orval was the first one to ever build a so-called fish tail type of spreader. This fish tail was very carefully designed. It had an outlet that was about six feet tall. It was a very narrow -- if you can just almost think of a vertical blade going through the field with a very narrow opening, say a couple of inches, but six feet long, so that you could put a fan shape spray right against a tree as you went along.

This worked out very well, and of course that's what happened with the speed sprayer; they needed this fish tail type of spreader and a lot of horse power for pumping air. The sprayer consisted of a blower to give an air blast and a spreader. Nozzles, mounted in the spreader, introduced atomized concentrated spray material under pressure into the flow of air coming

Bainer: from the fan. The air then carried the material into the trees. They were using air velocities of sixty to a hundred miles an hour. That really moved the leaves around and forced the spray into the trees.

To keep spray material in suspension in a four hundred gallon tank on a portable spray rig requires considerable agitation. French was after maximum agitation with a minimum amount of power, which took some engineering design. He was also interested in materials and paints for protecting this equipment. So he made quite a contribution to the pest control equipment of California. In 1947, he was offered the position of chairman of the department at Cornell and left us.

Norman Akesson came in as a understudy of French. And it was very, very fortunate that we brought him in (about wartime) because with Orval French eventually leaving, Akesson was there and the project didn't suffer too much. In fact, Akesson has carried it far beyond where Orval was. And another young fellow, Wesley Yates, that we brought in from Iowa State University even ahead of Akesson, had worked some with Orval. Then he worked with Akesson, and the Akesson-Yates team now is internationally known for their work in the pest control machinery area. Primarily they got into the problem of drift of spray materials. Because if they drifted onto other crops, they sometimes kill the crop. And so for many, many years, Akesson and Yates have spent practically full time on studies on drift from ground machines, from fixed wing, and from rotating wing aircraft. After the war, I can't remember just what year, but it was after I was chairman of the department, we bought a Stearman airplane for this important work, and we still have it. It's equipped for either dusting or spraying.

I never realized the dangers of drift until one day I was down in the field near Fresno. One of the farm advisors came up with a couple of cotton plants that had the leaves all curled up. He indicated that he'd like to know what was wrong with those cotton plants. Well, there was another man from the farm advisors office who said, "this looks like 2-4-D damage." (You see, cotton is very susceptible to 2-4-D). And sure enough, some of this 2-4-D had drifted, according to their story, some eight miles and landed on this cotton field, and it affected some of the cotton plants. Now, we do know that where there are grapes, like in the Lodi area, that most aircraft spraying has been grounded because of the danger of drift of the spray materials on the grapes, and of course, grapes are a broad leaf plant, and they really curl up with 2-4-D even if you might be a mile or two away. So, it's been a touch and go sort of a program. Actually,

Bainer: aircraft is much used in the state but it still has to be very carefully handled, and you have to watch for weather conditions so that you don't get the drift with the wind, for example. It runs in the millions of acres that are covered with aircraft every year.

A Growing Departmental Faculty and Related Research Projects

Bainer: Another man that Professor Walker brought in from Minnesota was L. W. Neubauer, who was brought in when J. D. Long left (Long went with the Plywood Association). Neubauer was brought in to take Long's place, and he's been here since the late 30's. And he just retired this last July (1972).

In the late 1920's J.D. Long had initiated a project on the use of earth as a building material. When I came to Davis in 1929, he was building a house for himself at 222 University Avenue using rammed earth (pisé de terre). The earth was rammed in place between forms. The walls were about 18 inches thick. Later when he added a wing on to his home, he used adobe bricks for the walls.

Work on adobe as a construction material was continued by L. W. Neubauer, who succeeded Long. Bitumal was added to the material from which the bricks were made to make them water resistant. I can still see the test wall, in the court back of Walker Hall, that was receiving water from a sprinkler for weeks on end.

A manual on adobe construction was issued by the University, which had a wide distribution.

Others who were brought in -- John Goss (who now is chairman of the department) from U.C.L.A. came here as a graduate student. He got his master's here. (We had two routes to Davis in ag engineering, one Berkeley and one UCLA. Actually we even had one through Stanford -- you could come here and graduate in ag engineering). Goss worked mainly on small seed legumes and harvesting problems of different kinds -- mainly grains, barley and wheat, and he taught some courses. He is chairman of the department. I could have predicted that when he was a student. I mean he just had the characteristics that you look for in running a show like ours.

Bainer: Another young man that we brought in was William Chancellor. He was a Wisconsin-Cornell product. He had two degrees from Wisconsin, one in agriculture and the other in mechanical engineering. This was the way they made an ag engineer at Wisconsin, a five year program, and then he went to Cornell and gothis Ph.D. He came here in the early '50's specifically to work in soil compaction problems. This soil compaction was just gradually creeping up on us due to the operation of so much machinery in the field. It compacted the soil, and in some instances you couldn't even get water penetration. The soils department had a young man here, Jim Vomocil He and Chancellor worked together over a long period of time, and made some very definite contributions to alleviate the problem.

And then we had the good fortune of inviting Dr. W. H. Soehne, from one of the institutions (Inst. Fuer Lansmaschinen) in Germany who had worked on soil compaction. He was brought in to work with these two fellows, more or less as an advisor, because he had had a lot more experience than they had. I had some rather interesting experiences with him. First, all of these European scientists have technicians, you know, just running around after them all of the time. (It's like in Spain right now. They provide two technicians for every research man.) And when Soehne came here, we had one graduate student working on this problem. And, of course, we had shop people who could build the equipment they wanted, but there was no technician picking up the tools or keeping up the data or anything. And Soehne told me, he said, "You know, I've done more work with my hands at Davis in six months than I've done in Germany in I don't k now how many years. But I like it. You fellows do more with your hands in California than we would even think about, and maybe it's some benefit. Of course it takes more time, and maybe it isn't the most efficient way." I was interested in this fellow with the idea of possibly some kind of a permanent appointment. He wasn't quite ready to leave Germany, but he was really intrigued with Davis by the time he got through. Then afterwards, I've heard from him every Christmas, and this must have been over fifteen years ago. He often mentions that he'd like to have another stint at Davis.

Michael O'Brien was brought here -- he was just a young fellow out of Iowa State College -- in vocational educaton. He had a doctor's degree. He was brought in, because at that particular time, this was about 1950, we were saddled with helping in the training program for VO-AG education majors and we had no one on our staff that was prepared or interested. We had to fill in. Even Jim Fairbank taught some courses for the vo-ag students in the interim period when Jim left the Extension and was in the

Bainer: department (He then went back into Extension).

Well, I went to Dean Hutchison and said, "If we're going to be saddled with teaching the specific courses in the vo-ag education deal, we have to have somebody on our staff that is fitted for this." And he finally agreed, and we brought in Michael O'Brien. Well, vo-ag teaching was more or less developed in San Luis Obispo and Fresno State and other state colleges. Our load in this program decreased, and furthermore, Michael O'Brien was so involved in teaching that it had an effect on his advancement. He wasn't doing any research, he was just loaded up with teaching vo-ag students. We couldn't move him up. It was a pathetic situation. You see all these promotions are based upon a balance between teaching and research. Mike took the bull by the horns and got involved in some research work, and became so involved that he pulled out of vo-ag instruction work.

One of the first things he got involved with was the bulk handling of fruit; work in handling peaches to the cannery in four foot by four foot by four foot bins. These bins hold a half a ton of fruit. He did a lot of work in the laboratory on simulated transportation where he vibrated bins of fruit like a truck would on the highway. He also studied the behavior of fruit over a distance of a hundred miles, say Yuba City to San Jose. He revolutionized the handling of fruit. Everybody just couldn't believe that you could pack a half a ton of peaches in a box and get there with anything except peach sauce. The interesting thing about this was that the major damage to the peaches en route was in the top layer, and this was due to what he called roller bruise.

Well, then came the tomato harvester. Well, when you're harvesting ten tons an hour how in the world are you going to handle tomatoes off that line in little boxes that only hold forty pounds? You see, the big problem was a mechanical one, how are you going to handle the fruit from this machine? And naturally, O'Brien had the experience in peaches and in plums and prunes, so he very gingerly started loading tomatoes into these large bins. And to start with they didn't fill them full, you understand, they put about six or seven hundred pounds in these bins, and they loaded the bins with fork lifts. Now, the latest in tomato handling (Mike O'Brien has been the pioneer on this thing) is simply loading the truck bed with tomatoes and hauling them in, in bulk and dumping them into water. You just can't believe that you could pile that much soft fruit into a truck without causing damage. The first bulk handling we got into was in prunes. And there, you're going to dry the product, and if you kind of mash them a little out of shape it's not going to make

Bainer: any difference, 'cause they are going to be dried. We've had instances of hauling tomatoes from Blythe on the Colorado river to Orange County. They'd harvest at night when the fruit was cooler, and get them on the road before it really got hot, and get them out. To bring them all the way from Blythe to Orange County is quite a haul.

Mike has been involved in other things. Now, when you put the tomatoes in the four by four by four bins, you have a problem of sampling. All of these loads of tomatoes have to be inspected. And so Mike built special bin samplers. Let's say here is a load of tomatoes, and it has twenty-four of these bins on it or something like that. And the inspector chalk marks, just at random, say, three bins that have to be pulled out of that load and sampled, and these bins then are taken to Mike's sampler (which was manufactured by the Blackwelder Co.) and any quadrant of tomatoes can be taken out of that bin. They're able to turn it upside down and pull out different quandrants along the edge.

And then came the problem of sampling at the cannery. And O'Brien built some flotation devices. He was able to insert a tube into the tomatoes, which had teeth at the bottom of it so that when he got the tube to the bottom he could close it and lift it out. He also worked on hydro-cooling.

The Hawaiian Pineapple group had O'Brien out there two or three years ago. And he developed the complete idea of a pineapple harvester. And I've seen pictures of it. I don't know what the status of that is, now. (I haven't talked with him since I retired.) I saw moving pictures that he had of this machine that went down the row and harvested pineapples. He made quite a reputation in Hawaii, in a short period of three or four months.

Others that we brought in included John Powers who's now associate dean of the engineering college. (He retired in 1972). In hiring John, Professor Walker quizzed Dean Bolter -- this was before he went to UCLA to start an engineering college; he was a professor of mechanical engineering at Berkeley.

Dickman: What year?

Bainer: 1938. We were initiating studies on the mechanization of sugar beet production. Bolter indicated that Powers was on his list as one of the top 10 graduates during the past ten years. Walker and I went down to Berkeley and had Powers, who was then transmitter engineer -- I think for KSFO radio station (his wife I think was still going to school) over for an interview. He was an electrical engineer. He was involved with the first installation of the vitaphone (talking pictures) around the country.

Bainer: Powers was very frank. He said, "I don't know a sugar beet from a red beet." But, we didn't care. We wanted somebody who was ingenious, and if you didn't know about these things, maybe you were better off. There were other people on the project who knew all about sugar beets. So, he was hired, and we'll discuss his work when we get onto sugar beet mechanization.

Another electrical engineer, who was a tremendous fellow, was Austin Armer. Austin Armer was a graduate in electrical engineering from Berkeley. He was a flutist in the University orchestra. He went to work for Magnavox, and when Magnavox moved out (they apparently had plants in California, which moved back to the middle west) he had to move with them. He, being a native son, was never acclimated to midwestern living. He was out here on a trip.

Dickman: What year was this?

Bainer: This was about 1939. We had a grant from the U.S. Beet Sugar Association for mechanization studies. Armer said "I'm willing to cut my salary in half to get back to California." And he worked for us in the parallel development with Powers on harvesting. In 1948 or 1949 he went with the Spreckels Sugar Company as Agricultural Engineer, and just retired a couple of years ago.

And then later, we brought in Roger Garrett. Roger Garrett is the man that's working on the lettuce harvester. He's the man who also developed the electronic plant thinner. He called it a synchronous thinner. We'll talk about that later on. It's now manufactured by John Deere.

We had some USDA men here who held titles in ag engineering. They were courtesy titles; their salaries were paid by USDA. But they worked on research only. They didn't teach. And we worked cooperatively. For instance, in the early days of sugar beet mechanization, the USDA sent a man in here by the name of E. M. Mervine who worked with Professor Walker. The rest of us had very little contact with his project. He was more or less pioneering in those early days. Then they brought another chap in here by the name of S. W. McBirney. Mervine then was transferred to Fort Collins, Colorado, to work on sugar beet problems in Colorado, and McBirney was left here. When the grant came through in 1938 to accelerate the program in sugar beet mechanization, Stan McBirney of USDA and I were then made co-leaders on this project. It involved about eight research people. (Sometime later we'll get into this -- sugar beet mechanization is a story all of its own.)

Bainer: Another man that was brought in earlier, from USDA was Clarence F. Kelly. Kelly worked on animal environmental problems mainly in Imperial Valley, but had cooperative work with animal husbandry here at Davis and did some of his work here, but the big concentration of work was under the hot climate of the Valley. Kelly was a good man, an excellent man, and USDA kept bothering him all the time with the idea that they'd have to transfer him back to Washington. And Kelly just didn't think he wanted to be an office boy back in Washington. This thing got to be almost a perennial problem with him, and I could foresee the time when we would need a man like Kelly in the department because Belton was reaching retirement. Several of our people had talked to Kelly and I had approached him, but he was very faithful to the USDA and he wasn't about to jump over the traces into ag engineering at Davis, until finally the pressure became so great that they were going to transfer him out of here.

Well, I talked to the chief (Arthur Turner) of the department of ag engineering of ARS (Agricultural Research Service), at one of the winter meetings of ASAE, in Chicago. I told him that Kelly had gotten the animal environment project rolling. That he was really doing some pioneering work. That he had wonderful cooperation with the animal husbandry group. I said, "I'm going to tell you one thing. If you insist on moving him away from Davis at this particular time -- he doesn't want to go -- I'll hire him." Well, I was assured that they weren't going to move him. Time went on for two or three years and this department chief passed away. His successor came in and the first thing you knew, he transferred Kelly to Washington. I went to Hutchison who was Vice Pres. of the University and unfolded this whole story to him. I said, "I just want money so I can hire Kelly tomorrow, and then when Belton retires, in six months, I've got his salary to pay Kelly, and you can have back what you let me have on the cuff to hire him now." And, he agreed to it. And I came back and I offered Kelly the job and he took it. The Kelly story includes the fact that he hired one of our graduates, Ted Bond, to work with him. He, Ted Bond, and Nick Ittner (who used to be the superintendent and the livestock man in Imperial Valley; he passed away several years ago) did some marvelous work. They did the pioneering in animal environment and did a great job and really made a contribution. Feed lots in Imperial Valley are still using the findings that came out of that project. When I transferred from ag engineering over to engineering and had to give up my chairmanship in ag engineering, Kelly succeeded me. After two years he was pulled down to Berkeley as assistant director of the experiment station,

Bainer: and then after a year, he was made director and he just retired from that job on February 1st, 1972. He spends a little time in Davis now. But I think he's going to go back to Washington.

Dickman: USDA?

Bainer: Yes, on a special assignment for a year or two.

The USDA man, who headed up structures, now retired, never forgave me for hiring Kelly away from him. I used to send him Christmas cards with notes just for the purpose of trying to mend this little rift. A year or so ago, he said, "You know, it was awfully hard for me to believe that Kelly did the right thing when he stayed in California." But he was now glad Kelly had stayed. Kelly had gone right up the ladder practically to the top, and his Alma Mater (North Dakota University) gave him an honorary doctor's degree. He was from North Dakota. We always kidded him, he and the famous orchestra leader, Lawrence Welk, both got degrees from that same institution. [Laughter]

Stan Morrison was hired to work with Kelly and Bond. After Kelly went to Berkeley, Robert Givens was stationed here by the USDA. These two are continuing the animal environment project.

Lloyd Lamoria was brought from Ames in the early '50s, and one of the projects that he worked was grape harvesting. (This will be described in more detail at a later time.) But Lloyd was a very effective teacher. He taught farm power. He worked primarily on a grape harvester, and then he left for industry. He went to industry for a while, then he became chairman of the department of ag engineering at San Luis Obispo.

As his successor to continue the grape harvest work, Henry Studer was brought in from Cornell, and he has done a real nice job.

I inadvertently left out two very important people who were teamed together in agricultural engineering to do specific jobs. One was Robert Fridley who we hired to work on the mechanization for harvest of tree crops. The other one was Paul Adrian, who was stationed here by the USDA to work with Fridley. These two men did some very significant work in pioneering the harvesting of tree crops, which we will get into later.

Dickman: This is an aside, but when C. B. Hutchison was Dean you had to work with him. Was he an easy man to work for?

Bainer: Very easy, I found. Some people had difficulty. I remember when I was made chairman of the department Professor Walker mentioned one day, "You'll have lots of dealings with Dean Hutchison." And he said, "There will be days that you go in there when it isn't the right day to talk." And I never found that to be true. He also warned me about Ira Smith, comptroller on this campus. I never had any trouble with him. I always felt that if you laid all your cards on the table from the very beginning and they helped make the decisions (even though you were making them yourself) they felt that they were in on the deal and did a lot for you.

Dickman: Would you say that you found the staffing of the department in pretty good shape when you became chairman or did you have real problems?

Bainer: No to the latter part of your question. Of course, Walker was a superman in the selection of people. He only missed on one or two. I would say that Walker and Fletcher (you see, some of these people were here when Walker came) were two good judges of human nature and had ways of evaluation. I learned something from Walker I can tell you. Even as early as '31, Walker asked me to evaluate Orval French and Herbert Stapleton. We were at an ASAE meeting at Ames, Iowa. Walker had had in mind these two men; both of them were K State graduates, and both of them had master's degrees, both of them wanted the job at Davis and we were to interview these two men. Walker asked me to personally do this on my own, and he would do likewise, and then we'd get together and compare notes.

I couldn't tell -- I mean, at that early stage I felt that both of them were highly qualified. That you could take either one of them. But Walker felt that Orval French had a little more down to earth side of him, made more applications and they probably were better, etc. And I think he was probably right. The other chap, I've followed him, is now a professor in another institution. He's done all right.

Appointment as Chairman of Department of Agricultural Engineering

Bainer: I don't know whether I really should tell this or not, but I think it might clear up a lot of erroneous opinion. In 1947 I was offered the chairmanship at Cornell; -- I really wasn't

Bainer: interested. I got a beautiful letter from Dean Wm. Meyers outlining the whole program. Salary-wise, it was a very good promotion. It was a nine months job and you had three months off. It was a four page letter and I still prize it to this day. It was beautifully done, etc. I took it in to show Professor Walker. And I said, "I'm letting you read this letter just because I think you'll be interested in it. But I'm telling you right now, this letter is not a pry for a promotion here. I'm going to decline this offer. I have thought this thing through and I'm not interested. I won't even go back for an interview. Don't think that I'm pressuring you for anything. I'm just letting you read it as a friend and I've told you what my decision is." Professor Walker, after reading the letter, came in and said, "I want two copies of this letter." I said, "I'm not going to give them to you. I told you this was just a personal letter and I don't want you to consider this as any pressure on you or on anybody else." He said, "I ask you as a friend. I want two copies." So I gave him two copies of the letter.

The next thing I knew, and this was only two days later, I got a telephone call from Vice-president Hutchison asking to come to Berkeley. It was a surprise, you know. I said, "I can come down Saturday morning." (We were still working Saturday mornings those days.) He said, "That'll be fine." So I drove down to Berkeley and had this meeting with Dean Hutchison. Dean Hutchison, who was a Cornellian, congratulated me. He'd seen the copy of this letter that Professor Walker had given him Thursday. He said, "You know, Walker resigned as chairman of the department." I said, "Well, this makes me sick. I let Walker see this letter, as a friend, and I told him my decision and I'm telling you my decision, I'm not even interested in Cornell. Even though I know it's your Alma Mater, I happen to know that they've got a bunch of dead wood back there, and I'd spend the next ten years chopping down the forest and trying to get things going. And I'd rather be the fifth man in an operation like Davis than the top man at Cornell." (And I'd already turned down a similar offer at Purdue.) Dean Hutchison said, "Well, Professor Walker was down on Thursday and resigned as chairman of the department. And I want you to become chairman." I did know that Professor Walker had had a little illness; had been out a little while, a month or two, and I think he was concerned about his health. He also felt that he'd like to do a little research to finish up, before he retired. According to Dean Hutchison, Walker had tried to retire as department chairman as early as five years prior to this. And Hutchison at that time said, "The war's on. We're not doing any teaching. Let's wait until the war's over to reorganize and get going again and then I'll listen to you."

Bainer: Well, the war was over. This was 1947. And Hutchison still hadn't listened to him. Walker had been trying to get out of the chairmanship for five years. I didn't know that, you see. So I said to Hutchison, "You know, I had a little sample: Walker took a sabbatical a few years back and left me in charge of the department." And I said, "I've had a taste of what goes on in that chairmanship, and I'm not really excited about being chairman of the department." He said, "You can't talk that way." He said, "Professor Walker and I both have been trying to groom you for this spot, and whether you know it or not, this is the path that we've hoped you'd take."

I said, "Well, I'll be very frank with you. Whatever the University wants me to do, as long as I work for the University, I'll do it, but I think I'll be happier just as an Indian down in the wigwam rather than as the chief." [Laughter] And he said, "You know, there really isn't any big rush, I guess. If you want to delay this for a year or so, it's OK with me."

You see, I really didn't want to see Walker leave the chairmanship because he was perfect for that spot. So I went home, and I must have really burned up the road because I got back before twelve o'clock. I went in to see Walker and I said, "I'm really surprised. You used my letter as an excuse for retiring from the chairmanship. Here was a letter to me wanting me to take a job and you used it in your own interest." And he broke down and told me about the whole thing. I said, "I talked to Hutchison and there's apparently no real hurry about this, and he suggested that maybe we could let it ride another year or two." Walker said, "You go to that telephone before you leave this office, call him up and tell him you'll take that job the first of July."

Dickman: This was when?

Bainer: Oh, this was April 1947. So that's how I became chairman of ag engineering. The dean at my Alma Mater misinterpreted this whole move. You see Walker used to be at Kansas and I was his student. This dean always figured that the chairmanship was for life, and here was one of Walker's students now who had displaced him. I found this out later on, about four or five years later, -- I was attending a seminar in Chicago, and one of the professors from Kansas was there and the dean had seen the list and said, "You're going to run into Roy Bainer," and he told him about this thing. We went to the ball game one night and this guy said, "I want to sit beside you." (He was a California product from Berkeley who was now a professor at Kansas -- he's still there.) He said, "I want to sit with you because Dean

Bainer: Durland was interested in some of the happenings out there." And he proceeded to tell me what Durland had told him: that I'd pushed Walker out. So I said, "I want you to straighten this thing up. I want you to go back and tell Durland the whole story the next time you see him."

Dickman: After having had this experience as chairman, you were talking about the concepts back at K State on the lifetime chairmanship. What's your opinion about the tenure of the term?

Bainer: I don't think a man should take on a job like that, in this day and age, for life. This was finally decided when Wellman was dean of agriculture, that the people in agriculture, at least, should rotate on a seven year basis. He could be reappointed, but would probably never serve more than two terms, but more likely one. All Deans are on a five year review basis. I know that I was really surprised. Here I was in the last seven years of my period with the University, and at the end of five years, when I only had two more years to go, I got a letter from the president saying that he was very happy that the review committee had been over my record as a dean and had approved my reappointment. I never even realized that I was up for reappointment [laughter] as dean for the next two years. I mentioned this to Dean William Pritchard in Veterinary Medicine. He came in the same time I did. Pritchard had received the same kind of letter.

Dickman: Is this also true of chancellors? There's a certain term?

Bainer: No, I don't think so, with chancellors. The deans are reviewed and reappointed. In many departments, you know, the department chairman is only in there two or three years. They rotate around the department. In the Department of History, or English, or Languages or something of this type, I can see that rotation would be much easier than the fellow who is head of ag engineering who has contacts all over the state and gets grants from different research groups. It takes him a long time to get on to all the ropes, and then after three or five years, to dump him, I don't think is fair to the department or to him. So I would say in agriculture where you have all these outside contacts, all this field work, that maybe seven years isn't so bad.

Dickman: It wouldn't be too difficult to say in seven years to go back into research --

Bainer: Yes, it would be. But fortunately, many of these department chairmen seem to be able to keep a little research going. I certainly tried all the time I was chairman -- either working on cotton mechanization or corn harvesting. Light jobs, but it kept my hand in.

Departmental Orientation: From Berkeley to Davis

Dickman: Let's talk about your teaching. Can you remember some of your students: some of the satisfying experiences that you've had with your students?

Bainer: Well, let's talk about the teaching first. We had a set up in the University of California at that time, in which the academic program in agricultural engineering was an option in mechanical engineering, and was handled out of Berkeley. In the formative period of ag engineering, which only started in '26, we decided that the easiest way to handle it until there were more people available at Davis, was as an option in mechanical engineering. Our students went to Berkeley for three years, and then transferred to Davis for a six-week summer course, and their senior year.

So all I was involved with at first were senior students. This was a real pleasure, because they'd all been screened by that time. We never had one man at Davis ever fail to graduate. That's quite a record.

Well, anyway, here was a very peculiar set up. You didn't have much control over your students until they came here, and they had to be dedicated ones to get here. So an orientation course was given at Berkeley for sophomores. It was handled by a man going down for a couple of weeks talking about his area, and another instructor would go for two weeks and talk about his area. I think there were eight instructors and each had two weeks, and there was little continuity in the course. So in 1929 Professor Walker was faced with what are we going to do about AE.12, that was handled in Berkeley. He called me one day and he said, "I think you and I will handle A.E.12; I'll take it the first five or six weeks, and you can take it for the rest of the semester. I'll handle farm structures, water supplies and sewage disposal. Let's give them a little meat; let's give them some problems to work, make them feel that they're tied in with ag engineering. You can handle power and machinery and pumps." It will just be kind of a physics course as related to agriculture. So I found myself in the Spring of 1930 going to Berkeley to give these lectures on Tuesdays and Thursdays. That's when there were plenty of trains (30 a day through Davis). I left at 7:40 in the morning and returned at 7:40 p.m. It was a long day.

We had an office down there and I used to get more work done there than I got done here. The class was over by eleven, and

Bainer: it was nice to get away from the hustle-bustle. We continued to do this for 25 years, and I didn't realize the good health of both of us for that period until the last year. Walker was going to retire in '52, and Knowles Ryerson who was on the Board of Directors of the school at Turialba, Costa Rica, asked Walker to go down in his place. Walker wanted to go the worst kind, but it conflicted with his stint at Berkeley. So he said, "You know, I'd like to go down to Turialba. I've never been down there. But, I can't do it unless we can switch this program at Berkeley and let you take the first half and I'll take the second half, and we'll just reverse the course". I said, "That's perfectly all right with me." We were also giving the course at Davis by that time. Well anyway, I suddenly realized that he and I had been teaching that course for 25 years, and this was the first time that either one had substituted for the other one.

Dickman: Remarkable! When did you stop going to Berkeley?

Bainer: About '56, I think. We still give it here, but not at Berkeley.

There were two times we missed the class. Walker missed it once when a flood covered the tracks between here and there and the train couldn't get through. And I missed it one time. I was on a train going down, and you will not believe this; we got down in the Suisun marshes, and the engine ran out of fuel [Laughter] -- on the Southern Pacific Railroad. This was before the diesels, it was an old steamer. And that gol darned train came to a stop and no one could understand it, and finally someone said, "What happened?" The conductor said "Somebody forgot to fill the fuel tank of the engine."

Dickman: Never would have happened on the Santa Fe [laughter].

Bainer: I hope not! I can tell you a funny thing that happened on the Santa Fe, since you brought it up. My father was out here about 15 years ago when a flood, down in the desert, washed out the tracks. They got busy and re-built them, and just as they were ready to roll trains, a second flash flood came and washed them out again. My dad, of course, was quite concerned. (You know, he didn't have any love for the Southern Pacific or The Union Pacific). I said, "Well, this is one time that the Santa Fe had to turn its freight over to the Southern Pacific." "Oh," he said, "what do you mean turn over to the Southern Pacific?" You know, he was quite indignent. "Well, then," I said, "you had to turn it over to the Union Pacific." He said, "No, no." I said, "Those are the only other two railroads that run into Southern California. You tell me how you got freight out of there." "Well,"

Bainer: he said, "we hauled it to Stockton on our own line, and then we switched over to Western Pacific. The Western Pacific handled it to Salt Lake City, and the D and R G handled it to Canyon City, Colorado where the Santa Fe picked it up again and took it to Chicago." [Laughter]

Dickman: All right, we were talking about teaching.

Bainer: Yes. I had the responsibility for teaching 104, which was a farm machinery course given for students in the College of Agriculture, a mechanized agriculture sort of program. I also had responsibility for teaching the professional students in farm machinery, which was more or less a design oriented program. I had two lectures and two three hour labs a week for one semester with the engineers, and two lectures and one three hour lab with the ag students. I had some help in the laboratories from time to time. Orval French assisted at first, Bob Kepner took the labs when he came on the staff, and Norman Akesson also handled labs. I still handled the labs for the seniors. I think I handled them all the way through, well, 'til the war time, anyway.

Teaching Activities

Bainer: We also had a six weeks summer session between the junior and senior year for the ag engineering students. We met with these students eight hours a day, six days a week. And we would develop projects with them. For instance, I would take a whole week, and then someone else would take them for a week. My project was the harvesting, dehydration and processing of alfalfa hay. In our neighboring town, of Dixon, there was a dryer, known as Dixon dryer. They produced what was called sun cured meal from alfalfa dried in the sun, and dried alfalfa meal. The plant at Dixon was run by an old bachelor by the name of Bill Weyand. I remember the first time I went down to see whether or not it would be possible for me to bring students in and make a complete, detailed, engineering analysis of his plant. Parts of it were pretty crummy. Also involved was the economics, cost studies and the like. The first reaction of the old gentleman was "I don't want to be fooling around here with a dozen college kids." I thanked him and I started out the door. Well he had just put in a Heil dryer, which is made up in Milwaukee. It was a concentric drum dryer that feeds the chopped alfalfa right into the furnace gases, actually, and dries it almost instantaneously. The leaves dry and are swept out of it in a matter of seconds. The

Bainer: stems take a little longer. You see, two methods for producing meal: one was sun cured, the other was artificially cured. I was disappointed, because here was an elegant place to take students and show them two methods, and compare the costs, and so forth, but I thanked him. And as I walked out the door he said, "I'll tell you what I'll do. If you want to bring those students in here it'll be OK if you'll give me a report on what you find out." I said, "Well, I'll tell you what I'll do. We will not have enough time in a week to make a detailed study that I'd want to put the University of California's name on. I'm not in that kind of business anyway, but if you will accept the best report turned in by a student, I'll have a copy made for you." So he agreed to this arrangement.

So we got an entry there. Weyand eventually sold it and the man who took over was Jerry Fielder who is now Secretary of Agriculture, you know, in Sacramento. [Fielder died in a small plane crash in 1972.] And Jerry welcomed us, and of course, they kept making improvements in this plant and it just made it an ideal place to work. Because we could go to the field and start with the standing alfalfa in the field and check moistures and carotenes (source of Vitamin A). We got the field experience of cutting this material, and hauling it in to the dehydrator. Then we had the experience of chopping hay at the dehydrator, and later on chopping at the field. At first it was all fed into the dryer by hand. Later it was automatically fed according to the temperatures inside the drum. We sampled it just before it went into the machine and got the moistures and carotenes again. We sampled it at the end and got the same data. Then it went through a hammer mill and was made into meal. We followed the meal in storage the rest of the summer. So we had the carotene analysis from the standing material in the field to the ground meal in the storage say four weeks later. So, as I say, it was a wonderful overall project.

We had to run in two shifts. We started at five in the morning and ran until midnight. We also checked power requirements and gas consumption. We were able to make a real financial analysis as well as a mechanical analysis. I'll never forget when the reports came in. There was one student who did so much better than the rest even though they all worked together.

Dickman: What was his name?

Bainer: Robert Davis. And so I took his report down to Bill Weyand and laid it on his desk, and visited with him and thanked him, and said, "This worked out to be a beautiful set up." Well, the next morning about 8:30 the telephone rang and it was Bill Weyand on

Bainer: the telephone, and he had the gruffest voice you ever heard over a telephone. He said, "Are you going to be in for the next thirty minutes?" And I said, "Yes, I am." "Well," he said," "I'm coming up."

I can still hear him walking down the hall. My office was all the way down the end of Walker Hall. He came in and slammed the report down on the desk and said, "This is the damndest thing I ever read." I said, "What's wrong with it?" He said, "Nothing. I just found out when I read it that I'm losing two dollars a ton on my meal, and I just raised my price this morning." [Laughter] "And," he said, "next year if you want to bring them over it will be perfectly all right." Well, all the while that I had those students from then on I made use of that dehydrating plant, and in the meantime, he sold it, and Jerry Fielder really modernized it. He put in automatic dumps, automatic feeding. Everything was automatic. He did all the chopping in the field. He, of course, put in other plants at Clarksberg, and another in Rocky Ford, Colorado. It was a wonderful place to take a bunch of kids, because you could do so much in a week.

Dickman: How long did you keep using this facility?

Bainer: Clear up to Wartime. And then, of course, we shut down during the war, and then after the war, it was decided that we were expecting these kids to take too much work. This was a period when they began cutting back in programs.

Dickman: So you eliminated that 8 hour a day 6 day a week course.

Bainer: That was six units of credit, you see.

Dickman: It should have been.

Bainer: And then some. But, you know, the kids never rebelled at that. They had an Indian student one year (now this is an amusing story). We had a student from India, and he was, oh, so inexperienced in dealing with college kids, you know. College kids are pretty sharp. They didn't really antagonize him but they were always playing little pranks on him, little jokes. His interpretation was that they liked him, or they wouldn't have done it. He took the right attitude.

They were all living in North Hall. Some of these kids found some fly maggots. (In vegetable crops they use sterile flies to pollinize crops, you know.) They keep these maggots under refrigeration until they wanted some flies, and then hatch out the flies, and they would be sterile. They propagated sterile maggots;

Bainer: they'd put a bag over the head of the plant they wanted to pollinate, add some pollen, and place one or two flies in it, and they fly around, and pollinated the plant.

Well, sir, these kids got a hold of a cup full of these damned maggots and put them under the Indians bed. And he came home one night, and his room was full of flies, and he shooed flies and he shooed flies, and thought he got them all out (and he never found the source,) and the next night he came home and he had a room full of flies [Laughter]. Well, this happened about three days before he looked around [Laughter] and found where the flies came from. [Laughter] I said, to the other fellows, "You're really treating him a little rough." And I also said, to him -- he rode in the front seat with me once (We had a truck fixed up with seats to haul these kids around). "I think they're treating you kind of cruel," you know, I felt kind of sympathetic with him. "Oh, I'm delighted," he says. "They pay all this attention to me, that means they like me." And they were really paying him a lot of attention!

Well, anyway, that course faded out in re-working of our curriculum.

Dickman: After the war?

Bainer: After the war. The College of Letters and Science was formed here in 1952. This meant that they would have majors in Chemistry, Physics, and Mathematics, and that gave us the basic courses we needed. (We'd never had them on campus before.) So, two or three years later, it was decided that we could give the first two years of ag engineering here. This eliminated the necessity to go to Berkeley to give AE 12.

Then we sent the students out to either Berkeley or Los Angeles for their junior year, and then they came back for their senior year. So that was the beginning of a whole revision of how ag engineering was taught, and eventually, of course, it all appeared at Davis.

Changes in Teaching Methods,

Equipment and Courses

Dickman: Has the method of teaching changed very much over the years?

Bainer: Yes, there's been a considerable change. I suppose the best way to get at this thing is to go back to my own personal experience as an engineering student at Kansas State University, then known as Kansas State Agricultural College. The programs in engineering, regardless of the curriculum, all carried a laboratory series, starting with forging, which is just plain blacksmith work on a forge, in which you made and tempered simple tools, did forge welding and things like that, and, of course, highly interesting. This was followed by another laboratory that ran through the whole semester in wood working, in which you did odd jobs of hand work in shaping woods, using a turning lathe, etc. This, then, was followed by another semester in pattern making; making patterns that would be used to form molds into which molten iron would be poured, to give rough castings. Following the pattern making, we had a session in the foundry, and actually, the campus had a cupola that was charged with iron ore and coke. We spent probably three-fourths of the time making molds, using the patterns that had been made in the previous term. There's quite an art in making molds. The instructor could really throw a monkey wrench in the whole machinery, and he did once in a while, by giving you a pattern that didn't have any draft, and that meant clearance. In other words, all patterns have to have a little slope to the side so that you can get the pattern out of the sand after you have packed the sand around it. If you want to have trouble, just get a pattern without any draft, and you can't get it out without destroying the mold. And then, of course, these molds sat around awaiting completion of enough to justify firing up of the cupola.

Dickman: What is a cupola?

Bainer: It's a vertical furnace in which you put in alternate layers of coke and iron, and I think they used natural gas to get the thing started, and then as the coke burned, and melted the pig iron, it became a molten mass in the bottom. A little trough led out the bottom of the cupola. A hole that led into the cupola was covered with mud. When they got all ready to pour, everybody got around with big ladles, usually handled by two people, and you got into position and the instructor would then tap the furnace and the molten iron would run into the ladle. Then you carried the molten iron and poured it into the molds.

Dickman: They're doing something like that right now at the Art Department foundry here.

Bainer: Yes, I'm sure they are. This is kind of returning -- I mean, people are interested in this sort of thing. Well, then, when these castings cooled you shook out the sand, separate the sand

Bainer: from the castings, and usually put them in a tumbler to remove adhering sand. You did some rough grinding to remove the lead into the mold, in other words, there had to be a lead to get the molten metal into the mold proper. That left one operation to be done, and that was machining these castings.

This was done in a two semester course in the machine shop. And at the time I was in school we were making wood turning lathes, that were sold to high schools around the state at cost. You felt that you'd done something constructive; you'd made the pattern, you'd made the mold, you'd poured in the iron and now you had machined the castings, and eventually they came into an assembly process. And, of course, the mistakes that were made in molding and in the machine shop could be dumped back into the cupola. Fortunately, if you made a mistake you could melt it up and rerun it.

Well, this has all disappeared, and in some ways it's unfortunate, because, while it really didn't prepare you for high level engineering, it gave you an appreciation of a good artisan, and it gave you an idea of how these things were done. But there just isn't room in an engineering program for all of this laboratory work. We've tried to introduce it from time to time in maybe a little different way; in that we now have engineering laboratories in which senior students are in charge of the lab and freshmen and sophomores become technicians working under the seniors and juniors. Dean Llewellyn M. Boelter tried this in UCLA, and I think very successfully. The nearest we have to this at Davis is mechanical engineering laboratories that are taken in the junior or senior year, usually the senior year, and they may run as high as nine hours a week in which they'll have a project and carry it through much the same as we did that wood turning lathe. It's a more sophisticated kind of a program, and we find that quite helpful to students.

The thing that has really come to the forefront in engineering education, of course, has been the basics. A tremendous amount of time is spent in giving the students certain tools to work with; he is well-based in mathematics, physics, and chemistry, and he takes far more mathematics than I took, for example. He is introduced to computers, and encouraged to use the computers, and I think the big revolutionary change has been the introduction of computers into teaching of engineering. With a computer the student can program a project or a problem that he might have taken hours and hours to work on, using the slide rule or calculator; mainly slide rule, as we all did in the early day. He can feed this data into the computer in the matter of seconds and know whether or not he has something which is actually

Bainey: from the castings, and usually put them in a tumbler, to remove adhering sand. You did some rough grinding to remove the lead into the mold. In other words, there had to be a lead to get the molten metal into the mold proper. That left one operation to be done. And that was machining these castings.

This was done in a two semester course in the machine shop. And at the time I was in school we were making some turning lathes, that were sold to high schools around the state at cost. You felt that you'd done something constructive; you'd made the pattern, you'd made the mold, you'd poured it and then how you had machined the castings, and eventually they came into an assembly process. And, of course, the mistakes that were made in molding and in the machine shop could be dumped back into the cupola. Fortunately, if you made a mistake you could melt it up and recast it.

Well, this has all disappeared, and in some ways it's unfortunate, because, while it really didn't prepare you for high level engineering, it gave you an appreciation of a good artisan, and it gave you an idea of how these things were done. But there just isn't room in an engineering program for all of this laboratory work. We've tried to introduce it from time to time in maybe a little different way; in that we now have engineering laboratories in which senior students are in charge of the lab and freshmen and sophomores become technicians working under the seniors and juniors. Dean Llewellyn M. Boelter tried this in UCLA, and I think very successfully. The nearest we have to this at Davis is mechanical engineering laboratories that are taken in the junior or senior year, usually the senior year, and they may take as high as nine hours a week in which they'll have a project and carry it through much the same as we did that wood turning lathe. It's a more sophisticated kind of a program, and we find that quite helpful to students.

The thing that has really come to the forefront in engineering education, of course, has been the machine. A tremendous amount of time is spent in giving the students certain tools to work with; he is well-based in mathematics, physics, and chemistry, and he takes far more mathematics than I could, for example. He is introduced to computers, and encouraged to use the computers, and I think the big revolutionary change has been the introduction of computers into teaching of engineering. With a computer the student can program a project or a problem that he might have taken hours and hours to work on, using the slide rule or calculator; mainly slide rule, as we all did in the early day. He can feed this data into the computer in the matter of seconds and know whether or not he has something which is actually

Bainer: workable. In other words, the computer may just spit out a bunch of garbage or it may give a finished solution. So that this computer program that is now available in most engineering colleges has speeded up the solution of problems, and thereby, making it possible to solve more problems than we did before.

Dickman: I suppose the students learned, even when they put garbage in and got garbage out.

Bainer: I suppose. Learning what will not work is just as important as learning what will work.

Dickman: Do you think in time, with increased use of these computers, that you might even be able to reduce the amount of college time maybe from four years to three years?

Bainer: It could be. Students in engineering and the sciences spend a tremendous amount of time solving problems. From beginning to end, an engineering education is a problem solving exercise, you might say. And certainly, when the only facility you have is a slide rule, it takes hours and hours to solve problems. Now with a computer, which will give you an answer almost instantaneously, you'd expect to at least be able to cover more ground, and possibly do the work in less time.

The only problem with shortening up the period is that there's so much new information that the student should become acquainted with; he's got to do more library work, more reading, and cover a lot more ground than a student of fifty years ago. And so, for that reason, I'd say you probably won't be able to shorten it, but it's going to mean that he can cover more territory in the same time.

Dickman: How did the old faculty learn the new computer technology? This lab that you talked about was for faculty as well as students?

Bainer: No, we don't teach computer in that shop. No, I would say that the older faculty probably haven't learned to use the computer as they should have. It's the young fellows who are coming off the graduate lines in the various schools; when we started the College of Engineering at Davis, the first fifty Ph.D. grads that we hired had taken their advance work at thirty different institutions, and these were all outstanding schools. We were very careful in the selection of schools from which we were going to draw this talent. And these fellows coming in, all had an opportunity, and most of them had some computer experience. We haven't really had this problem at Davis, and I notice that even in ag engineering, where we've had a staff here for many,

Bainer: many years, that these people are using a computer, too. What happened on campus was that courses were given in FORTRAN to anyone who wanted to take them, and knowledgeable people; students were able to pick up programing to at least take care of their immediate needs. So too the faculty.

The use of the cathode ray tube now in design is coming into the forefront. I anticipate that there will still be many, many changes. I do know this, that our graduate students like to work up their own equipment; and build their own apparatus that they're going to use in their project. We put in a third shop about four or five years ago that was designated for faculty and students. We have ag engineering shops which are primarily for fabrication of experimental machinery. We have engineering shops that build teaching equipment and help the graduate student build their apparatus. The third shop that we have is under the supervision of a highly qualified machinist Fred Lory. He's a journeyman machinist, who's on duty all week. He supervises students who might want to do some work themselves, and certainly helps them in setting up a lathe or drill, or whatever he might be doing. He keeps a log of how the shop is used, and much to my amazement, the students really love to go in there and putter around. I say some of it's puttering, but the problem, of course, is to keep them from coming in for personal work. We try to hold this to bonafide project work.

The literature, of course, in engineering, as in every other walk of life now, is getting to be so voluminous that I don't know where it's going to end; I mean as far as utilizing all the findings that are being reported in the literature. It takes a wide awake instructor to keep up with the literature, and he, of course, needs to take a sabbatical leave once in a while to refresh himself with time to go into the literature. I'd say most technical books are outdated probably by the time they're printed. This is just how fast changes come.

Dickman: Someone was telling me yesterday (John Powers, as a matter of fact) that there are more divisions in electrical engineering now, in that one discipline, than there were some years ago in the entire field of engineering.

Bainer: Yes, I expect there are.

Dickman: The literature must be enormous, as you have said.

Bainer: Oh, it is. No one could possibly keep up with it, and that's why we have so many specialists nowadays. We used to think of an engineer being able to meet most every situation that comes

Bainer: up. Well, he still ought to be able to, but he certainly hasn't had that sort of background and education by the time he earns his BS degree. If he goes on for an advanced degree, he goes on, in a very, very narrow way, and he may do a pretty careful study in a very special field. But this is a problem in all education, to be able to cover the whole field in a satisfactory manner so that the man can use the information that's available to him. But it's getting pretty rough. And I don't know what the libraries are going to do. They're just going to run out of shelf room.

Dickman: I suppose that the pressure to publish expands the amount of literature to some extent?

Bainer: Well, I suppose what it amounts to is that some of that literature gets on the shelves before it's really mature. You know what I mean; the man is anxious to be sure that he's out ahead of the crowd. He gets an idea, and even though it might not be fully developed, and maybe this is OK, he lets go, and you've got a publication. And then he'll follow up and probably add or amplify what he's reported, and it'll probably be all right.

Dickman: How is this juried? Whose responsibility is it to see that the article is right for publication?

Bainer: Oh, every scientific body has a magazine or a journal committee. Nothing goes into the Journal of Agricultural Engineering that isn't OKed by the review group. That certainly takes the burden off the editor. Many editors of these journals are not highly scientific people, they want to help everyone they can, and they can't publish everything that's coming through. There is a selection. There are Journals, and then there are Transactions. I mean, you know, second and third level publications within an organization. And everybody is hoping to get his material in the Journal. But it can only take maybe six or eight articles a month, e.g. the Journal of Agricultural Engineering, so we have the Transactions that come out and take the overflow. We're getting pretty full coverage, but there's still a lot of material that never gets into print.

Use of Video Tapes in Teaching

Bainer: One of the things that I should have said about changes in teaching methods, improvement in teaching: I failed to mention the use of video tapes. I feel that this is one of the great opportunities

Bainer: that we have for this new program in extended education throughout the state. Our first experience with it at Davis was in connection with applied science program which centered pretty much on the Livermore campus. In 1963, the Regents extended the College of Engineering at Davis to include the Lawrence Radiation Lab at Livermore. This, then, qualified Livermore to enter into a educational program utilizing some of the real high power scientists that they have down there. We have used up to thirty of these scientists on a ten, fifteen, twenty percent basis to handle graduate students. Some of them actually gave advanced courses in various areas. This, of course, worked out very, very well. We had a program at Davis involving fifteen or twenty students while the Livermore group ran about eighty.

Well, Dr. Edward Teller, of atomic energy fame, was really the instigator of the Livermore program. He had tried to bring about a cooperative arrangement with Berkeley and failed, primarily because Berkeley had the radiation laboratory on the hill right back of the campus; they didn't have to go to Livermore. He finally made the connection here, and that's when the Regents authorized the initiation of a program of applied science, and they gave us permission to do it.

As I mentioned, Dr. Teller was very active in this program to begin with; he was chairman of the department. He gave courses, and one in particular that we would have given anything to have had him give at Davis for fifteen students, but it just wasn't in the cards. So we made arrangements with Teller to set up a remote controlled camera and recording system, in the class room at Livermore. I failed to mention that we had a temporary building for class rooms and a library down there. Chas. Nearing from this campus, went to Livermore twice a week and made a video tape of Teller's lectures. He was never in the class room while the lecture was going on. He was in a little van where he had his equipment and his monitoring screen, and by remote control he could keep the camera focused on Teller and the blackboard all the way through.

Dickman: This class was on matter?

Bainer: Yes, it was on the properties of matter. And we had one of our young faculty members, Carl Jensen from Davis in applied science, go down and audit the lectures each week, and he brought the tape back and played it for a class at Davis. He was available for discussion and any one who wanted to see the tape a second time, could. And at the end of the semester the students at Davis were given the exact same examination on the same day as Livermore.

Bainer: And this gave us an opportunity to compare methods and surprisingly, I suppose, to some, the students at Davis did as well on the examination as the ones at Livermore, which certainly would make one think that here was a very effective tool for teaching.

Several years before this particular incident, the Bakersfield Junior College (which had a very effective pre-engineering course under the very capable man E. M. Hemmerling) made use of video and plain tapes, to cover lectures on some of the more difficult subjects that students were having problems with. These tapes were available so that students could play them back one or two times after a class to re-hear the lectures. This program was very effective.

Now, we have improved this video tape deal by setting up a microwave lane between Davis and Livermore with a repeater station on top of Mount Diablo. We are now booming regular courses from our class room in areas other than applied science. We're sending lectures in mechanical and electrical engineering, to a group in Livermore that preferred to have something other than applied science. And this was just instigated last fall [1971] so that we only have the fall quarter so far, but there is a group of scientific people in the Livermore area in addition to the Lawrence Radiation Laboratory. General Electric and Sandia have research facilities down there. This T.V. link is two-way audio, so that a student at Livermore that's listening to the lecture from Davis, can push a button and talk, then, to the instructor to get a clarification on any point that he might have missed, and so there can be discussion even while the class is going on.

I am confident that this is going to be one way of extending the university out over the state. We are looking forward to using the same facilities to boom lectures into the Sacramento area. (Televised lectures to this area were initiated during the Fall quarter 1973).

Dickman: This is an undergraduate class? You're talking mostly about undergraduate classes?

Bainer: Both. Most of this is undergraduate now. It's preparing these people for graduate work, upper division courses. I think there's something like ten courses. So, there's no reason why the university can't have these receiving centers strategically located in industrial areas where there's a concentration of people that want to take further work, and it shouldn't be just limited to engineering.

Dickman: How about lab work?

Bainer: This is going to be a little more difficult. There are several groups now studying the future of extended learning in California, and one of the things that has been proposed is that practically every city of any size has a junior college or city college, and with state colleges located strategically around the state, co-operative arrangements are possible between the agencies trying to extend the learning through out the state to use laboratories in some of these junior colleges or state colleges. This has to be worked out.

Dickman: Now, who would be the lab assistants?

Bainer: Probably the people in the state colleges or at the junior colleges, but there would have to be people from the university available from time to time to work with these people. And certainly those people who are in this sort of program have to be given full credit just as though they were in a class room at Davis. And this is one of the problems that we have always had with extension teaching; that the teacher only got brownie points for it. He was paid extra, but it didn't really count toward his advancement. And this has to be changed.

Dickman: While we're talking about these things, would you say something about Dr. Teller himself?

Bainer: Teller, is of course, a very remarkable man, very brilliant. I've heard him lecture on many occasions, and I have never seen him use a single note. It all comes out in a highly organized manner just from within. I mean he doesn't seem to prepare any lecture notes, but he seems to be organized within his mind, and he can bring his story out very effectively. He has the tremendous ability to be able to talk to his audience, whether they're top scientists of the nation or whether they're just laymen, women, or students. I remember, I think in the fall of '63, when we were just starting our engineering college, we thought, of course, it would be very well to have these students meet the professors. We had a social hour for them in the commons, with a speaker from the faculty. The freshmen that particular year knew that Teller was about, and they wanted to know if it was out of line to ask him to be the speaker for this meeting. I said, "Well, of course not. He's a member of the faculty." So they arranged to have Teller talk to them. When the night came that Teller was going to talk to these students, the spokesman for the group said to me, "Well, you're going to introduce Dr. Teller, aren't you?" I said, "No, you asked him to speak, so you must introduce him." Well, I never saw a group of students more on the edge of their chairs for an hour or more as Teller told a story relative to atomic energy, and he kept stressing the peaceful

Bainer: uses of atomic energy. As I say, he was effective in any audience.

As part of the Davis program at Livermore, Dr. Teller, of course was a great influence. He started working on the computer manufacturers, and the first thing we knew, Control Data Corporation (that's CDC) came through with a gift of a little over a million dollars. This computer is for the use of applied science students. It was in addition to all the other computers. You know, Livermore has one of the greatest computer centers in the world.

We had to rent a building outside of the laboratory so that the students would have access to it 24 hours a day. The students in applied science, both Livermore and Davis, can use the computer. Each student, of course, is taught how to run the computer, and we have an attendant there most of the time. You would be amazed at the hours the students worked that computer. It didn't make any difference whether it was night or day, you would find students there at two or three o'clock in the morning. They could program what ever problem they wanted. There were several theses that were completely worked out on the computer -- and this was always amazing to me. But I suppose we've had lots of garbage dumped out of that computer down there, because it was so easy for people to get into it and try various combinations or some half-baked ideas that didn't have a solution. But this was a tremendous asset to the whole program, having a computer available all hours of the day and night, just for student use.

Dickman: Dr. Teller is still at Livermore and this is an active, on-going program?

Bainer: Yes, he's still connected with the program. I should mention that Dr. Teller was most successful in attracting funds for fellowships. Over a period of five years, over four hundred thousand dollars were obtained. Of the most lucrative sources for fellowships was the Hertz Foundation. Teller succeeded in getting 13 of their fellowships during one year. Each was for three years paying $5000, $6000 and $7000 progressively for the three year period.

RECOLLECTIONS ABOUT FORMER STUDENTS

Dickman: I imagine that you had some interesting experiences with your students. Would you talk about any that you recall?

Bainer: Well, actually, when your classes are small, you get better acquainted with your students than in the larger classes. For example, the course that we gave at Berkeley was open to anyone who wanted to take it to find out what agricultural engineering was about. The fact that we made it worthwhile by insisting on problems each week, the enrollment at Berkeley in that class was up to 80 students, and they weren't all ag engineers, and, of course, meeting with them twice a week for half a semester, you never got acquainted with many of them.

Contrasted to that, at Davis, I think the largest senior class we ever had was 23, or something like that, and lots of times it was only a dozen, so you got pretty well acquainted. And naturally, they were much closer to you than in the case of the large classes. And I would say, probably, the most outstanding example that I can give you of one of our students was the case of Robert R. Owen.

Bob Owen came up from Berkeley as a senior in the fall of '41. He was also enrolled in the advanced R.O.T.C., so he had eventually an obligation to the Army. Came the spring semester, and, of course, as you know, we were in World War II by that time, and they were pushing these people in advanced R.O.T.C. along as fast as they possibly could. The university appeared to be willing to accelerate their programs and get them out as soon as possible, and so we accelerated Bob Owen's program, and he finished up a little bit before the end of the semester. We could do that, again, because the classes were small.

Well, Bob came in to bid me goodbye, and said, "This is going to be a long war, and I'm getting in on the ground floor of it." (He was going in, I think, in heavy artillery.) "And," he said, "I'll probably make a career out of the Army." I said, "Bob, if you do it's going to be the biggest disappointment of my life." I said, "It's fine that you're going to go ahead and do your duty now, but when this war is over, I want to see you, just don't make a career out of the Army. Your brains are just too good for this sort of thing." I suppose I was just a little bit too brutal. I said, "The Army needs good people, but you can serve them and make your contribution and then get out."

When the war was over, Bob couldn't get out of the Army fast enough. I found out, from one of his close college friends, that

Bainer: he'd been in the artillery and they kept making him an instructor, and he wasn't getting into the action. All these young guys wanted to go where the action was. So he left the artillery and went into a deep diving unit down in Florida with the idea that he was going to be a frog man and mine some of the harbors in Europe.

When his contingent was shipped out to Europe they shipped him to Seattle and made him instructor in the deep diving outfit up there. [Laughter] He never got off the Continent.

He did one very heroic thing up there, though. Very few people probably recall that during the latter part of the war, there was a bus load of school children that slid off of a shelf road into a lake that was two hundred feet deep. And, of course, it drowned all of the kids, but they had the problem of getting the bus out. And Bob Owen volunteered to go down in two hundred feet of water and attach chains on the bus to get it out. This was the sort of guy he was.

Well, when the war was over, here was Bob Owen. He said, "Well, I've got my discharge and I'm ready to go to work. What do you know about jobs?"

I said, "You know A. M. Jongeneel from Cal Pack was here looking for an ag engineer to work in Hawaii. If I were you, I'd call him up and go down to San Francisco and see him. He may not have found anyone yet." So he went down to San Francisco and they offered him a job in the islands with California Packing Corporation -- pineapple production. And, he went over.

They had a lot of engineering problems of spraying, fertilizing, planting, and harvesting pineapple, and Bob was coming along very well. He built some unique pest control equipment. About three years later, Dow Chemical observed some of his work and enticed him to come back to the United States and be an agricultural engineer for them. He stopped at Davis on his way to Dow Chemical, and, of course, he was looking for his successor in Hawaii. I just quizzed him a little bit about the salary end of it, and of course, during the war, salaries were stationary. (It was a long time before salaries started going up.) He said, "I went to Hawaii for $3800 a year, and when I left there, I was getting $8100. And I don't know what they'll pay a new man, but it'll be in that range." Then he volunteered that Dow Chemical was paying him $10,000. He'd only been out of the army about three years, and I thought that was pretty good for a kid.

After one year with Dow Chemical, the director of the Pineapple Research Institute in Hawaii resigned. The only man that the

Bainer: Hawaiians could think of was Bob Owen, who they'd let go to the United States. Of course, he'd only left the year before. Well, they hunted him up and took him back to Hawaii to direct their Research Institute at $15,000 a year. And he was there for quite a while. I think he felt a little isolated, you know, being over there. So he got a leave of absence from the Pineapple Institute to come to the mainland to observe manufacturing processes, and went to the Ford Motor Company, of all places. He just wanted to get out and get an industrial leave for experience. He intended to go back to Hawaii after the year here.

While he was on this industrial leave, two requests came in for ag engineers. One from Vickers Division of Sperry Rand Corporation, which builds hydraulic controls and hydraulic motors. The director of research for Vickers had at one time been on this campus, Dr. N. E. Edlefsen, who was in irrigation. He was a physicist, actually, and that's a story all of its own. I mean, Edlefsen was the co-inventor of the first cyclotron. The man who gives him that credit is Dr. E. O. Lawrence, who got most of the credit, but Edlefsen did this as a graduate student at Berkeley. Well, this is beside the point.

Edlefsen had two daughters living in Davis. One is Ruth Anderson who has been the Dean of Women here on the campus, and the other, Elaine is married to Dr. T. Y. Cooper, a physician in town. And so Edlefsen was here periodically. Whenever he was in Davis he came and talked to me. On one of his visits he was looking for a man to work the agricultural end of hydraulic controls, and I told him about Bob Owen who had built a lot of experimental machines in the islands, and had been involved in hydraulic drives and controls. And he said, "Where is he?" And I said, "Well, he's in Detroit now." He said, "He sounds good to me."

So, he hunted him up, and offered him a job. Well, about the same time, the Ford Motor Company called me. The tractor division wanted somebody in product planning. I gave them three names in succession. All of them were employed, but were people I knew who were well qualified. They had already approached all three and had been turned down. Well, I said, "I've got a fourth man who has the potential, but not the experience you're looking for." I said, "This man is Bob Owen."

Well, I never heard another thing for a while. One day, I think it was about six months later, I guess, I saw Edlefsen again and he told me that Bob had turned him down. I said, "What kind of a salary were you able to offer him." "Well," he said, "he was making $18,000 at the Pineapple Institute, and I offered him $22,000." So I never thought anymore about it, until I got a

Bainer: letter from Bob, saying he would be in Davis next week, and would stop in and see me. So he stopped in here and said, "I just left the Pineapple Research Institute, and I'm going to Ford." And I said, "You turned down a pretty good job at Vickers, didn't you?" He didn't know I knew the background.

"Well," he said, "Sure. I think I'd like to work for Vickers but you know, Ford came along and offered me fifty percent more salary." [Laughter] At Ford he went right up the ladder. He was second from the top in the tractor engineering division.

He always had a feeling of loyalty to Davis, even though he only spent one year on this campus. So one day I got a letter from him saying that he was setting up a scholarship fund, and that he would give $2,000 a year, and the Ford Company would match it. (Some of these companies match what you give to your alma mater) So there was $4,000 a year coming, and he wanted part of it used immediately for scholarships and part of it put into endowment fund, so that's what we did.

Well, things went along, and as I say, every time they had a re-organization of the Ford Motor tractor division, Bob moved up. And I'll tell you, it was the biggest shock in my life --

Dickman: When he left?

Baienr: When he left. He wrote me a letter, saying "You're really going to be surprised, but I just took a job as President of the Great Western Sugar Company in Denver.

Dickman: He had never had sugar beet experience?

Bainer: No, no. He was just that type. He could just adapt himself anyplace. Well, he did work for us a little bit that fall on sugar beet harvesting, but that was all of his contact with sugar beets. He said, "That was worth a lot to me tho', [Laughter] just to know what a sugar beet was." He said, "Well, you're probably going to wonder what's going to become of my scholarship fund, but I'm going to give the whole $4,000 myself now." [Laughter] Well, anyway, this went along, and this sugar company got in the hands of a kind of -- oh, a banker crowd -- and they began to milk it. And, the first thing you know, Bob was out. I got a Christmas note from him, and I know from other sources, that the farmers now are buying the sugar company. They're putting up the money, and Bob is going to be the president of the new sugar company when this is all consummated. (According to Wall Street Journal the deal will be closed on Dec. 30, 1972)

Bainer: So, he is just a tremendous guy, and he says that most of the real motivation, or confidence in himself, or whatever it takes, came from his experience at Davis. When I retired, they had a retirement dinner for me, and my secretary, Mrs. Eldora Synhorst knew that Bob called me regularly. You know, we talked regularly over the phone. We were very close, all these years, from way back in '41. She sent him an invitation to the dinner. He had the use of a company plane, a Lear jet, and two pilots. He flew in here for my retirement dinner. He was due in Washington the next morning for a meeting, so they fixed up a bed in the plane, and these two pilots picked him up after dinner and flew him to Washington. This is remarkable! He was one of the greatest kids I ever knew. (He isn't a kid anymore.)

You know, he had a very serious accident. He was putting up storm windows on his house in Detroit and fell, breaking his back. He knew something was very seriously wrong. When people came up to help him, he said, "just leave me alone, boys. I want some experts to handle me. I'm seriously hurt." The fact that they were careful in handling him, saved him from any after affects and you wouldn't know it now.

Dickman: Any other stories about your former students?

Bainer: Oh yes. Frank Peikert -- during the Depression years (and I always had great respect for him in his attitude) had to work every dime of his way through college. He went against his father's wishes. His father just thought it was foolishness for him to go to college. Frank was so determined to go that he worked at Lodi making boxes for a grape packing plant. He got to be an expert box maker. I remember, he'd go down to Lodi on Friday night after school, and by Monday morning he had made enough boxes for this packing house to use all week. And he made pretty good money at it. He worked all summer, and then, as I say, in the fall he made extra money. When he graduated in '32 there weren't any jobs.

Dickman: That's when I graduated. [Laughter]

Bainer: I said, "Well, Frank, you can always go back to making boxes." And oh, that was the worst thing I could have said. "Why," he said, "I have worked four years at that place and they all know that I was working hard to get through college and I'm not going back there and say that's all I can do after I've been four years at the university!" [Laughter] That was a good lesson to me.

"Well," I said, "The El Solyo Ranch near Modesto is looking for some fellows. It's a temporary job, and you could probably get

Bainer: some good experience. It wouldn't be bad to go down there and work for them." To get away from Lodi was what he wanted to do. I also suggested that he apply to several institutions that I knew in years gone by that had fellowship programs for graduates who wanted to work on a Master's Degree. And so he applied to these places, one of them was Ames, as I remember. Nothing came through immediately. The Fellowship of Ames had been awarded, and Frank was the number two man. So he took the job at the El Solyo Ranch. About the last of August, he got word from Iowa State College that the man who had accepted had now turned it back, and if Frank wanted to come to Iowa State and get his Master's, the job was his. Well, he came through Davis on his way and he said, "Boy, I got a lot of good experience, but I just felt that after four years of concentrated studies that I ought to be able to do something better than this." Times eased up some in the next year or two. He got his master's at Iowa State, and then went to the University of Georgia as an assistant professor. Later he went to Texas A and M. Finally, he is now chairman of agriculture engineering at Penn State.

Dickman: I am interested; that's my college.

Bainer; Oh, it is! Well, one of the interesting things is that when he went to Ames, this favorite aunt of mine that I mentioned before lived 8 miles out in the country. She had married a farmer, and she had three children, and the oldest daughter had never looked at a guy in her life. She was a school teacher. I wrote a letter to my aunt Martha, that a young fellow from here was going to be at Ames for a year going to school, his name is Frank Peikert, and he just graduated here last June. I mentioned that he was a kind of diamond in the rough. "Maybe if you had him out, you and my cousin Jeanette might be able to polish him a little bit." You see, that because of this terrific difference with his folks, there was something wrong, you see.

Well, sir, the first Sunday after receiving my letter, my aunt and cousin went in and found him, and took him home to dinner. And that was the beginning of love at first sight, and he married this cousin of mine, so he married right in the darn family.

Dickman: [Laughter] That's a great story!

Bainer: We've had a lot of interesting students.

Dickman: How about the Weeth boys?

Bainer: Waldo Weeth, the father of Evan and Harold was in the first class that I had to pick up and teach when I told you that Stirniman had

Bainer: gone to Russia. Waldo Weeth was a senior that year in agronomy, and one of Ben Madson's favorites, incidentally. Waldo apparently had a very tough struggle to get through. They tell me that he babysat and scrubbed floors, and did everything possible to hang on here and get through, but he also played football. He was one of the greatest football players we ever had around here.

Anyway, he was in this class 104 for ag students. I got acquainted with him mainly in the lab. (I met the laboratory section then. There weren't too many in the class. I think there were only six or eight.)

Well, Waldo went out of here and took a job with the University down at Imperial Valley as director to the field Station. He became interested in flax. Flax was a new crop in California about that time. He did a little work on flax threshing, and eventually ended up at Fresno with the Flax Growers Association. While he was on this job, he saw an opportunity to rent a little piece of land, and the first thing you knew he was farming a couple of hundred acres on the side. He gradually got into farming, and eventually left the flax group. And now, has one of the greatest operations on the west side of Fresno County out near Coalinga; cotton, and hogs and cattle. And has done very, very well, and has developed a raw piece of property out there. (Incidentally, he sold the ranch in Oct. 1972 and is developing a cattle ranch in the foothills) Well, his two boys came to Davis, and this was just right after the war. Harold did very well, and was no problem to Waldo, but Evan was going to Davis, maybe against his wishes, I don't know; I understood later on that part of the problem was that his father wouldn't let him bring his automobile. They had just a little rift, anyway. As a result, Evan just wouldn't study; he just wouldn't apply himself. He was on probation, and Dean Briggs, who was also a great friend of Waldo Weeth's, because Waldo maintained contact with the University, just hated like the dickens to kick Waldo's son out of the college, but that's what it was beginning to look like.

Well, Evan enrolled in my class AE12, and I'd been told ahead of time that he was a perpetual flunker, that he wouldn't do a thing. They said, he'll come to class, but he will not work. And this is probably his last semester in college, because he just isn't doing anything, he's wasting his time. So, I tried to be friendly with him, but I couldn't even get a smile out of this guy. I mean, he was surly, and was just down on everybody. It was a pathetic situation. There was a psychological factor there. Well, anyway, I watched him. I gave out problem sets that were due the next meeting of the class. I watched him go out the door, without leaving his problem set. Well, I expected it. I had been told

Bainer: that he wouldn't do anything, so the following Tuesday when the next problem set was due, he started out the door, and I started right out the door with him, and I took him by the arm, and led him to my office. I have never been so rough on a student as I was on him. I knew the background, and the family, and the whole works, -- I just tore him to pieces. The next week, the two back problem sets came in as well as the new set. He never missed one after that. Except for a couple of foolish mistakes on the midterm and final exams he would have received an A. As it was he got a B. And it was the only course that he passed; he got an F in all the rest of them. Well, of course, he still had to be dismissed.

The alumni had a meeting here, and Briggs told me about it afterwards, and I was glad I was out of town and didn't get to attend. Waldo Weeth was on the committee here investigating teaching. This was after his son's experience, and the story that Briggs told me was that Waldo got up and said, "There is only one man on this campus that can really motivate the really disinterested student." And he gave me a heck of a build up. Well, as I say, I'm glad I wasn't there.

Well, the payoff came, later on. Evan joined the Air Corps, and flew jets all over this world. Then he got tired of it, and came back, married a girl, with a baby, and went to work, back on the ranch.

One day I was down in that area, and whenever I was near the ranch I always stopped in to see Waldo. I drove in the ranch this morning, and much to my surprise, Evan was working in the shop, and I didn't even know he was out of the Air Corps. And, he seemed to be very friendly, and this experience he had had been very worthwhile. As I was ready to leave, he said, "Before you go, I'd like to talk to you." So I said "OK." When I bid his father goodbye I went by the shop to see Evan. He said, "I just wanted to tell you that I'm down here at Coalinga Junior College making up my deficiencies, and I'm going back to Davis and show those old guys that I can hack the program." And I shook hands with him and told him what a wonderful experience this was, certainly, for him. The payoff came the night of commencemnt. In those days we had the commencement out on the Quad in the evening, because, you know, it's pretty warm here in June. I was going across to the Union where we put our caps and gowns on to march in the procession. As I got to the quad, here was Waldo and his wife, Wilma, parking their car. When they saw me, I shook hands with them; the tears just rolled down their faces -- the fact that their son had finally found himself and was going to get his degree from the University of California was almost too much for

Bainer: them. So, I mean, it was a real payoff.

Dickman: You bet it was, beautiful! And you had a few more experiences?

Bainer: I don't want to go into too much detail here, but Ernie Blackwelder's son Bert got into scholastic trouble at Berkeley.

Dickman: Ernie Blackwelder is the man who developed the --

Bainer: Tomato harvester. Yes, and he's the president of Blackwelder Manufacturing Company. But anyway, Ernie and his brother both graduated from the University of California at Berkeley, and here Bert had all the potential of graduating, too. He had been an excellent student in high school, but for some reason or another he got into scholastic difficulties at Berkeley and was out. He was in ag economics, as I remember. Ernie came to me one day and he said, "You know, I just don't know what we're going to do with this boy of mine." Ernie was quite upset. He said, "It isn't because he doesn't have the brain power to do it, but something's happened. He's lost confidence in himself. I don't want to ask any favors, but if you could just look into this thing."

The next time I was in Berkeley I went into see Stan Freeborn, who was the associate dean of the college of agriculture, and I told him about the Blackwelders, and this boy who was having difficulty. And, I said, "He's been dismissed. Is there any way that we might encourage him, maybe to get into another program? Maybe the economics was just something he wasn't just too much interested in. How about vo-ag program [vocational agriculture] or something?" Well, we talked about him for a while, and, of course, Stan Freeborn was a very fair individual, and always wanted to help these kids. He said, "Well, I'll tell you what I'll do. I'll let him back in providing he goes to Davis and reports to you." And so, he came to Davis and got a room in the dormitory. He went out for track. I didn't think he ought to, but, you know, he had to have some diversion. He started to win a race now and then. And I think the fact that he started winning at track was kind of a morale builder for him. You see, he was a little more attractive to the other people. He didn't have any problem after he got up here. He just picked right up, and the first thing I knew he had transferred back to Berkeley and graduated. And then he went to Stanford, afterwards, and got a master's in Business Administration, and now he's the president of the Blackwelder Co., and his father is chairman of the board. I don't know, it just seemed like a little bit of an interest in him did help.

Bainer: But the one that I really put almost in the class with Bob Owen was Ted Bond. I knew his folks in Manhattan, Kansas, actually, I knew this kid ever since he was a little guy in knee pants. His folks then moved to Davis. His father took more or less a technician job in animal husbandry. So, he started in Davis, and this was just prior to the war, and then went to Berkeley, and didn't make it. He was going to be an ag engineer, actually, and he just didn't seem to make the grade and he was out. Well, he came to me to talk about his problem. There was another instance where I went to Freeborn and got him back in. I persuaded him to go into vocational agricultural teaching. I thought that it would be a dignified program for him, and it at least got him back in school.

Then he was drafted and was stationed in Italy. He wasn't in the front lines. He had time on his hands, and so started taking correspondence courses from the University ofCalifornia at Berkeley--these extension courses by correspondence at least gave some background that he needed. Then he came back from the war and got back into Berkeley, and finished up and came up here and got his Bachelor's degree in Ag Engineering.

When he graduated Clarence Kelly was here as the USDA man in the animal environmental program, and Kelly was looking for another man. I got ahold of Ted, and I said, "Why don't you take this job with Kelly?" I said, "You are a structures man and you're interested in animal environment."

Well, he just couldn't quite make a decision, but finally he decided to do it. Actually, after he'd been on this job quite a while, he did very well, and Kelly was very well pleased with him. He decided that maybe he ought to go a little further with his education. So he came in one day, and he said, "I think I'll (he was married and they had a baby) go for a master's degree." And I said, "Where are you going to do it?" He said, "right here." I said, "No, you're not going to do a master's degree in structures here; the very best man in structures is Henry Giese at Iowa State College, and that's where you're going to go." Even his wife came in and said [laughter] "This better work out, or your name will be mud," you know. "We're going back to live in one of the barracks on the campus for a year."

Well, they went back there (and here's a fellow who had a real struggle to get through the university scholastically) and went through his total graduate program and made thirty-three units of A's at Iowa State College. They offered him an assistant professorship when he got through. Well, he had this job with Kelly, and

Bainer: he liked what they were doing, so he came back to Davis. And a few years later, he said, "Maybe I ought to go for a Ph.D." And, I'll tell you, this was rough for him. You let ten, twelve, fifteen years go by, and for a guy to go back in the rough company of Berkeley for a Ph.D. He did part of work here and part at Berkeley, he got his Ph.D. And he then succeeded Kelly. When Kelly moved out of here, Bond took over his job. He's always been with USDA. We've offered him a professorship here at Davis, but he just doesn't want to leave what he's doing. About four or five years ago the USDA decided to put up an animal research center at Clay Center Nebraska. This was on about 8,000 acres of land, big research facilities. By golly, they moved him back there and put him in charge of developing all of the facilities. I had a letter from him recently-- he's been loaned to AID to assist on a project in Africa. These people that get into trouble sometimes, they come out of it with a little bit of encouragement, or motivation, and you find out that they make it one way or another.

There's another really very interesting story involving an entirely different situation. A man who graduated from the University of California about 1915. His name is Rene Guillou. Well, Rene Guillou graduated in engineering from the University of California about 1915, and was practically the perfect student, and became the University medalist for that year. And just as a side-light, he returned the medal to the Regents and told them to melt it down and use the gold for fellowships.

Rene may have harmed his health a little in his studies, I mean, in his concentration, he worked very hard as a student, and apparently the family had a little piece of property up in, I think, Marin County, maybe it was Sonoma, it's in that area, and Rene was married, or had got married soon, and went up there and operated this farm; no cows, just mainly to recuperate. And then a couple of babies came along, and he stayed on that farm until they put the two girls through the University. The next we heard of him was when Ben Moses was in San Diego and met Rene on the street. He said to Rene, "What are you doing down here?" Rene said, "I'm taking a sabbatical from my farm, and I just thought I'd come down here and get a job in the aircraft industry; just something different. I've leased out my farm."

Ben headed up our CREA program here at Davis (California Rural Electrification Program) and he had a part-time job open in the CREA which would permit a man to do some graduate work, if he wanted to. So he said to Rene, "Why don't you come up to Davis and take a half-time job in CREA, and maybe go back to school?"

Bainer: And Rene thought that was a great idea. He said, "I never even thought of that." Well see, Ben knew him during college days. So Rene came in here, and this was war time, I couldn't tell you exactly when it was, but he started a graduate program in engineering. I know he was fifty years old then or thereabouts, and he made another straight A program and got his master's degree. Then he shipped out on a merchant marine vessel as an engineer, and was in the Pacific during a lot of the war period, keeping diesel engines running on this ship. From there he went out to the University of Hawaii, in ag engineering, I think he headed up the department out there. I went through there on my way to Japan in 1948, I remember, and I had to stay all night in Honolulu. I got ahold of Rene and he came out and had lunch with me the next day before I shoved off. He then came to UCLA after that and was on the staff with Boelter. Ryerson who used to be the director here, had a project in the Pacific during the war, and they had him down in the South Pacific. Ryerson was developing some agriculture on some of those islands. He took some people from here and also got ahold of Rene Guillou at UCLA. Rene became ill on the job and developed a cancer, and came back to the states, and had a very serious operation. The doctor gave him one year to live. So he went up to Hidden Valley, above Roseville, where his brother-in-law was developing a tract, and helped him. He bought a lot and built a home for his wife, so she would have a place to live when he was gone. At the end of the year, the doctor told him he was completely cured, he was A-1. And so he wrote me a letter, about the first of July, 1954. He was sixty years of age then. In his letter he said that he wanted to use me as a reference, that he was going to take the examination for a professional engineer.

We had a cooperative project in deciduous fruit packaging and cooling, with Warren Tufts, who was Chairman of Pomology. We had been looking for an engineer for this project. It was well financed for five years. When I got this letter from Rene Guillou, I went to Warren Tufts, and I said, "Do you know Rene Guillou?" "Do I know Rene Guillou?" he said, "He and I shared a tent together in civil engineering camp when we were freshmen" -- (Warren Tufts had started in civil engineering, I didn't even know that; he finally gave up and came out the horticulture route.) But they had corresponded and kept in touch with each other ever since. He said, "Do you mean that Rene Guillou might be available for this job?" I said, "He's available, now whether we can interest him, that's something else." "Well," he said, "we're all through looking if you can get him!"

I didn't know where Hidden Valley was, so I got in the car and just started out. It was the first of July, I remember. I drove

Bainer: around the country up there and inquired, and finally found this little Hidden Valley. And it was hidden, too! I drove around the valley, and finally they told me where Guillou's place was. When I knocked his wife came to the door, and she was expecting him soon. And so, I thought, I'll just wait for a while. I'd gone to all the trouble to find the place. [Laughter]

I had with me a copy of the project that we were going to start. I talked with him for a while, and he seemed to be a little interested in it, and I said, "I'm just going to leave the project with you so you can study it over and think how you might fit in." On the fifth day of July, Rene Guillou came to my office ready to go to work. And this was the most fortunate thing for this project that you can imagine. This man really made some real contributions. Then it came time for him to retire. He was in the State retirement system, and I knew that there was a possibility of extending people's times under certain circumstances -- and we hadn't finished the job. It had been five years, all right, and Rene had finished the job as far as he was concerned. He summarized his work in two bulletins, because he figured he was going to be through. But there were still a lot of things to do, if we could just possibly get him extended. So, I went to the State and got him extended three years. Instead of working five, he worked for eight years. And I often thought what a magnificent experience this man could have had had he come right out of college and gone to work instead of just juicing those cows for over twenty years. [Laughter]

Well, now, Rene is, of course, retired, and he is now doing the consulting that he thought he would do ten years ago, but he had something to really get his teeth in to; something that's worth consulting on. His idea of the forced air-cooling and improved packaging is now being installed all over California and Arizona, and he is the expert. He has had all that he wanted to do in consulting work all the way from Arizona throughout California. So, it's been a real experience for him.

CO-AUTHOR OF TEXTBOOKS

Bainer: After the war, I failed to mention, and this really gets back to teaching, but it's going to be a lead in to why we brought a certain man here. Right after the war the Harry Ferguson Company had made a lot of money and they set up a Foundation trying to use this money to the advantage of ag engineering. They had a director of this foundation who was agriculture engineering oriented, and they sponsored a seminar after the war which ran about ten days at Purdue University, and invited every instructor and pro-

Bainer: fessor of agricultural engineering in the U.S. and Canada to attend at the Foundation's expense. (We hadn't taught at Davis during the war) I think there were seven or eight from Davis who went back to Purdue, and it was a very wonderful session. They put on a program, and it was just what we needed right after the war period, kind of getting everyone rejuvenated and back on the track. And out of this seminar, of course, came a clamor for text books. We really didn't have any suitable texts in the whole field of agricultural engineering at an engineering level. And so the Ferguson Foundation set up a grant. They designated sixty thousand dollars in ten thousand dollar grants to individuals in universities to prepare a manuscript in his particular field. There were six of these. Barger at Iowa State got one grant to prepare a manuscript on Tractors. He enlisted me as a co-author. I got the grant for the machinery text in California, and I persuaded Dean Hutchison to let me hire Kepner for a year on my ten thousand dollars. So I actually paid Kepner to do a lot of the spade work. So Kepner and I then wrote the book and Barger collaborated.

There was another ten thousand dollar grant made here to Perry, on agricultural processing. And Perry then hired S. M. Henderson from the University of Georgia, who came here for one year to work with Perry on this book. The point is Henderson was brought in by Perry with the OK of the institution, and after they had completed the manuscript, there were some openings here and Henderson stayed, and he's been here ever since. (He's getting close to retirement.)

Dickman: Will you add further details to the story of the two textbooks?

Bainer: Ed L. Barger was a freshman when I was a senior in college, and then of course I was on the staff there for three years after I graduated and I got well acquainted with him. Barger was one of the key individuals at the time. He was a professor at Iowa State College. He had been on the faculty at Kansas and Arkansas before going to Iowa State College.

I mentioned the big teaching seminar that was held at Purdue following the war. It was sponsored by the Ferguson Foundation. They put up all the travel money. Out of the seminar came a cry for improved teaching materials including textbooks. The Fergusson Foundation then put up sixty thousand dollars--ten thousand dollars for each of six manuscripts. This money was made available to the senior author. For example, that gave him money so that he could hire somebody to do the spade work. There was a lot of digging that had to be done. So Barger kept after me, he felt that he would like to have me as a joint author on the tractor

Bainer: book. Then he volunteered to be a joint author on the machinery book. Barger hired Carleton, another K State graduate, to do the spade work. Carleton was at Michigan State. McKibben was the other author. McKibben had done this very beautiful analysis of the dynamics of wheel type tractors which had to go into this book. I gathered material on air cleaners and air filters.

Dickman: Did you write some of the chapters?

Bainer: No, actually I didn't write a single chapter in the book. I was more in an advisory capacity. I read and critized the manuscript. The responsibility for the machinery work then came to me and I was given a ten thousand dollar grant from the Ferguson Foundation. That gave me enough money to hire somebody full time. Well, this thing dragged along for a year or two. Everybody that we'd think about for the spade work wasn't available. The man that I really wanted was Bob Kepner. He was here at Davis. Everytime we would talk about anybody helping me I always came back to Kepner. I said, "I just don't know of anybody else in the United States." And finally I went down to see Dean Hutchison and I told him about this grant, and that I needed somebody do the spade work on this book. It involved some travel and a lot of library work. I told the Dean that I'd like to pay Kepner's salary and let him work a full year with a leave of absence from the University. He said, "Well, why not?" He said, "Do you know that some of the most important college texts came from Davis." He cited Robbins in Botany, Storer in Zoology, Roadhouse in Dairy Industry and others. He said, "Why shouldn't the best book in machinery come out of Davis?" That put us in business and Kepner worked a full year on that project. And this of course was done right after the war before salaries got out of hand. You couldn't do that for ten thousand dollars now. But, ten thousand dollars hired Kepner for a year, a stenographer for a year, and paid for all the art work. Maurice Johnson, a young fellow who had worked for us as a draftsman before returning to college, prepared all of the line drawings for the book.

Dickman: What was the significance of taking a fundamental engineering approach to the book on Farm Machinery?

Bainer: Well, it was the first time it had ever been done. We wanted to make this thing as basic as possible. We wanted to make it a book on principles so that it wouldn't get out of date too soon. You know so many of the textbooks that had been written in the ag engineering field were descriptive with pictures of machinery that was in vogue at the time. Well, it doesn't take very long for a book to get outdated just by the illustrations. In our book we didn't put a single picture of a completed machine in it.

Bainer: We just used the elements of the machine. It was published first as a lithoprint by Edwards Brothers in Ann Arbor, Michigan, and used in this form for two years to pick up flaws and mistakes. We called it "Elements of Farm Machinery." We had a contract with Wiley, but they gave us permission to publish a preliminary edition as long as we didn't use the final title. The first year we made arrangements with fifteen schools to use the book. You can have a lithoprint made very cheap, you know, just paper-back. Well it was evident that at the end of the year we couldn't have the book in its final form ready for the following fall. So we wrote all the people that had been using it and some others that this lithoprint edition would be available one more year before we got out the final copy. The second year we had thirty-one schools using it. The criticism we received from Professors was disappointing to us. We thought we'd have far more criticism. The greatest criticism we got was from engineers working for machinery companies.

Dickman: What was their criticism?

Bainer: Mainly in our treatment of materials of construction. This book was reprinted three times and served for seventeen years. The title was "Principles of Farm Machinery," a second edition was published by AVI Publishing Company in 1972. In the revision more emphasis was given to the design of farm machinery.

We've carried Barger. He is still a co-author. He's served as an advisor much as I did in the tractor book. When they revised the tractor book I said, "Leave me off." I didn't feel I was contributing enough. I just felt guilty about having my name on it.

Dickman: Did you take a sabbatical when you wrote this book?

Bainer: Yes, this was very necessary. I had to write certain chapters and I couldn't find time to do this. I worked all of my vacation time in the summer and worked weekends. I just got to the point where I was worn out. You just can't go day and night on something like this. All I had to do was to carry two courses for half a semester. So, it was only about six or eight weeks that I was teaching two days a week in Berkeley and two days here. In Berkeley, of course, I had an office and I could take my work and get a tremendous amount of work done down there. And here I moved my office over to veterinary science. They gave me an office without a telephone and nobody ever knew where I was. My secretary never revealed my location. And you just can't imagine how

Bainer: much you can get done if you don't have any interruptions.

Dickman: Did you need all of the six months?

Bainer: No, I didn't. I thought I would but I finished my part in five months. I still had some leave time, so I loaded the family up and took them to Kansas to visit my wife's folks while I visited experiment stations in the deep south. I stopped at all the important state experiment stations, and special stations like the rice stations in Beaumont, Texas and Crowley, Louisiana, and the cotton station at Stoneville, Mississippi. Without having a single appointment ahead of time, I saw every person I wanted to see on that trip except one.

Dickman: You were a very important visitor!

Bainer: It was a funny thing. I knew the man at Alabama in Chicago, for the professors seminar at International Harvester. I knew I wouldn't see him. But I saw everybody else that I had in mind that I wanted to see. In one case in Louisiana they had to call a professor at his home. When they called him and told him I was here he was over in fifteen minutes. And only one time did they expect me. At Stoneville, Mississippi they expected me because they were holding a letter from my wife. But I thoroughly enjoyed that trip.

Dickman: How many foreign translations have these books had?

Bainer: The tractor book was translated into Chinese by an agricultural engineer with a sugar company in Taiwan. And last fall I found out that the machinery book had been translated into Russian. We had a Russian professor here. He was in the United States for a year studying at Wisconsin. He had permission to travel around and came to Davis for two days, and the group here asked him to give two seminars. I attended them. When I entered the door the man in charge of the seminar motioned for me to come over and meet this Russian professor. When he was told that my name was Dean Roy Bainer, he said, "Oh, I've known Mr. Bainer for years." And it was a funny reaction. I looked at him and I said, "I don't think we've ever met, have we?" "Oh no, we haven't met, but I've known of you for years. The textbook that you and Kepner prepared is the standard for Russia." He said, "We have it translated and have printed ten thousand copies. It's used in every agriculture school in Russia." He thought this was a high honor! And to me it was a steal but I didn't say anything. After all he was a guest. [Laughter] I felt like saying something like "Where are our royalties." I heard a rumor that when I go to Russia there will be money available in my royalty account that

Bainer: I can spend in Russia. So I've got to look into this. Maybe it would pay me to go to Russia. [Laughter]

The power book was also translated into Chinese and Russian. This professor said, "Haven't you seen a copy of the Russian edition of your machinery book?" I said, "No, I haven't. [laughter] I was just a little bit taken back." He said, "Well, I'll see that you'll get one." Well, I never did expect to get one but about Christmas time here came a dog eared, moth eaten copy of the book. I know it was his personal copy. He probably couldn't get a new copy to send out so he gave me his own copy.

Dickman: What did the New York Public Library have to say about these books?

Bainer: When they came out, both books were placed in the upper one hundred best textbooks for that year, on the basis of meeting a need and on composition.

DEVELOPING DEPARTMENT OF AGRICULTURAL ENGINEERING RESEARCH:

Rice Harvesting Research

Dickman: I'd like to ask you now about research; let's start with rice harvesting research.

Bainer: Well, this was the first research project that I became involved in when I came here in 1929. The project involving the use of a combine had been written up by Professor Stirniman. He had been carrying on some rice harvesting work prior to 1929, but I think this new attack was the turning point in the whole project. I mentioned earlier, after the completion of the field work in the fall of '29, Stirniman went to Russia for the Russian government for a few years, so I inherited this project from him. I had had good tutelage from him that first fall, because he was well-organized and knew what we were looking for.

I might say in the beginning, that prior to 1929 all of the rice was harvested with the binder, shocked, field cured, hauled to a stationary thrasher and threshed. This took a minimum of probably two weeks to give time for the rice to cure in the shock. By curing I mean dry out so that it could be safely stored. This

Bainer: rice was cut with a moisture content somewhere between twenty and thiry percent, and in order to be low enough for safe storage, the moisture content would have to be below fifteen percent.

Well, one of the problems, of course, was competition with the weather in the fall because harvesting took place in October and November. And sometimes we get rain in those months. There were years, I was told, that threshing was delayed until the following March. In the meantime, of course, there was a great loss in the quality. The other factor was the expense of this method of harvesting. In the first place, the binder cut a swath about five feet wide. It took an auxiliary engine to drive the binding mechanism. This operation was followed by two or three men who picked up the bundles and set them up to form a shock that would shed rain. In shocking, the heads were at the top, and then they usually capped the shock with one sheaf to protect it from the weather and carry off moisture that might fall in the form of rain.

Stirniman had looked around for a place to do the work. He had worked with the irrigation people. There were two rice stations at that time: one at Biggs and one at Cortina in Colusa County. He learned that River Farms, which is a large irrigated farm west of Knights Landing, had two thousand acres of rice, and that they were going to cut by a method known as the Windrow-Pickup system. A windrower that took a twelve foot swath, cut and deposited the rice on top of a stubble. The windrow was about three feet wide. After three or four days in the windrow, the circulation of air around the swath was sufficient to reduce the moisture content down to where it could be picked up with the combine, threshed and safely stored.

We set up at the River Farms in the fall of 1929, and put in moisture testing equipment and decided to follow that harvest all the way through. Then, after the harvest was over, we analysed samples and worked up the data. The situation was, there was a considerable amount of deterioration in quality as a result of the Windrow pick-up method. This was due to too rapid drying of the rice in the top of the windrow. Stirniman had evidence that there was a deterioration in quality of the rice in the shock. He had measured temperatures in the shock and found these temperatures to be considerably higher than air temperatures. And we did the same thing in the windrow. We found we had temperatures in the top of the windrow that were even higher than in the shock. Very few people realized that rice is a very flinty grain, and if you remove the moisture from the outer layers of the grain too rapidly, the grain can't maintain its moisture equalibrium. In other words, the moisture at the center of the grain can't move to the outside as

Bainer: fast as you might take the moisture from the outside. As a result, these kernels check, actually fracture but don't separate. And we call that "sun check". When they're milled there's likely to be breakage along the cleavage line, and as a result, there is a lowering of the amount of whole kernels that you can get from any given amount of rice. We call the whole kernels head rice.

We were a little disappointed in this windrow method because there was more sun checking than we were getting in the shock. There was a greater exposure of the rice to the sun rays in the top of the windrows than there was in the top of the shock. Especially if you shaded it with one bundle broken over the top.

We also found that there wasn't any need to windrow the rice for the entire season. For example, we were running moisture content of the rice standing in the field, as well as in the top and bottom of the windrow, and after it was threshed. There was a time, maybe two-thirds of the way through the harvest, when the standing rice got down to twelve percent moisture. It was ridiculous to put this rice through the windrow method. So, we persuaded the company to pull their windrowers out of the field and put their regular headers on the combine and just cut this rice like it was wheat. And, the interesting thing, again, was that by the time the moisture content in that rice got down to twelve percent, it was 100% sun checked. So that the yield of head rice was pretty low.

That same fall, 1929, an Italian rice grower by the name of Charles M. Cerati, at East Nicholas, Calif., had imported a dryer from Italy. (And, incidentally, I visited the place in Italy many years later where this dryer was built.) The dryer was built by his brother, and was known as the Cerati Dryer. And Charlie Cerati had grown up in the Po Valley of Italy on a rice farm. I've been told that they have a little different custom in Italy than we have in the United States, in that he went to his father and requested his share so that he could emmigrate to the United States -- his share of the assets. And he came to California in the early twenties and started growing rice in the East Nicholas area. He couldn't produce the quality of rice that they were used to in Italy. So he imported the dryer.

He didn't have any combine in 1929 to cut this rice as he should. He was still binding his rice and running it through a stationary threshing machine, but doing it straight from the field to the thresher then to the dryer. So at least he was getting the rice into the dryer with enough moisture to make it worth while to dry and also to eliminate the sun checking.

Bainer: We got permission from him to study his operation, and soon learned that rice coming from his dryer was far superior to anything we were getting anyplace else (head rice yields were over 60%). So, we changed our project and more or less concentrated on a direct combine-artificial drying method. Following threshing, the paddy rice was dried in stages -- not trying to reduce the moisture from twenty percent to fourteen percent in one pass through the dryer. This dryer had three stands with tempering bins over each. The rice passed through one stand to take out two percent moisture, for example, and then was elevated to the tempering bin above the second stand and twenty-four hours later passed through the second stand to take out a couple more percent, and then the third stand.

Furthermore, the temperatures at which this drying took place was maintained at less than a hundred degrees Farenheit. Actually, Cerati maintained a temperature of ninety degrees. He used all the products of combustion [in his case from a coke furnace] through the dryer. Later on he burned butane gas, there was no heat exchanger, it was just simply taking all the products of combustion up through the dryer stands and discharge them through the rice to the air outside.

One of the most important things that we learned through this deal was the fact that if you're going to get maximum head rice yields, you had to get the rice out of the field before it dropped below twenty percent. Otherwise, you began to get sun checking in the field. And once this was understood, and once this method was adopted, and everyone understood that you couldn't force the drying, high quality rice was produced. Actually the total time in the dryer was reduced by about a third if you used a tempering period between passes through the dryer. That was in the early thirties. By the end of the thirties (it took quite a while for this thing to catch on) and we still had rice being cut by a binder and threshed in a stationary thrasher, even though it was more expensive than direct combining and artificial drying. Of course, few changes were made during the depression years. The farmers finally adopted the new method. We got pretty well set up by the time World War II came on. And, when the war came on we did something that I know we couldn't have done with the old method, and that is, triple the acreage of rice in this state in a period of a couple of years, and were able to handle it with the new method. We couldn't have handled it back in the old binder-stationary thresher days. The result of these studies was published in UC Ag Exp St. Bul #541 Sept. 1932 entitled <u>Harvesting and Drying Rough Rice in California</u>.

Bainer: This method, of course, spread to other states, and it is now common practice. There was another pioneer in this deal, a farmer by the name of Joe Golbach. Joe Golbach was a neighbor of Cerati's and a very clever mechanic, as well as being a good farmer. He took a look at the Cerati Dryer and essentially copied it without Cerati's permission. [Laughter] When he copied it, he simplified it. It was very effective, and he started selling dryers. He and Cerati became very bitter enemies as a result of his action.

Well, Golbach did one other thing which made a very important contribution (and this was about 1932). He built a complete rice harvester. (There have been several people who have built them since.) He took an old Case combine and mounted it on a Caterpillar chassis, and attached to the front a ten foot header, which cut the rice ahead of the tracks so you didn't have any problem of running over uncut rice. That was the first straight through combine for rice that we had in the United States.

Well, it was a few years later that some of the companies came out with straight through machines, but old Joe Golbach was the pioneer in that thing.

Dickman: Was this the first dryer built in the United States?

Bainer: There were one or two companies building grain dryers. None had been used in rice until then. I think Golbach built a half a dozen dryers. Golbach had made some money and he wsn't anxious to stay on the farm. He was pretty easily satisfied, and moved to Sacramento. When he moved, he sold his dryer business to a company in San Francisco, H. M. Shanzer Co. They still put out that dryer, and it's called a Berico. The name was coined by taking B-E from beans, R-I from rice and C-O from corn, so it's the Berico Dryer, and this dryer is used quite a bit through the United States. There are other successful dryers built. But, the pioneering on this whole thing came right here in California.

If you remove the hulls from a hundred pounds of paddy rice [the rice that you get from the thresher] you have 80 pounds of brown rice left. Then, if you put that through the polishing procedure, to remove the bran and polish you remove another ten percent of the weight. So that a perfect yield of polished head rice would be seventy percent.

Well, we found out at the very beginning that this guy Cerati was getting yields back that were in the sixty-five, sixty-seven percent bracket, nearly perfect.

Bainer: Why anybody wants to mill the rice I've never understood because I've always felt you should be eating the brown rice rather than the milled rice. But, at that time seventy percent of our production was going in export. It was going to countries like Hawaii, Japan, and Puerto Rico that demanded polished rice. So we had to polish it and even coat it with talcum powder. Not talcum powder that you think of, but a powder made of talc, which is stuck on the polished kernels. Full mechanization is one contributing factor why we can produce rice in California for about 7 1/2 man hours per acre.

Dickman: Compared to what it is in Japan, about nine hundred?

Bainer: Yes, I found when I was out there in '48 that they were putting the equivalent of about nine hundred man hours per acre.

Dickman: Is it the same way now?

Bainer: Not quite, but there are areas where it even takes more. Laos, for example, I would say that they still put more than that into production.

Dickman: When did they start using airplanes for seeding, and did you have anything to do with that?

Bainer: No, we didn't have anything to do with it. We observed it in later years. The airplane was used for the first time in 1929. An account was published in Ag Engineering in Feb. 1930. E. N. Bates of the USDA made this study. It was an emergency measure on a farm west of Merced, California, that had been planted to rice, and wild water fowl had come in as it sprouted and cleaned out a section, maybe 160 acres. The field had been flooded, and by the time it could be drained it would be too late. Arrangements were made with the Merced-Wawana Company in Merced to reseed that field. They had a two-seated bi-plane. The front seat section was used as a bin for rice. A spreader mounted underneath distributed the rice. And, of course, they knew little about such an operation. So rather than take a chance of having skips between passes, they used flag men on the ground, and planted half the rice flying east and west and half of it flying north and south, so they went over the ground twice where they might have done it one time over. But the interesting thing was even with the late planting in the water, that the rice yielded practically as much as the earlier planted rice.

This was the beginning of a new era of seeding from the air. Several people who got ahold of bi-planes began to rig them up for seeding. The new method almost died the first year or so

Bainer: because they contracted for more planting than they could possibly do in the alloted time. So, very soon farmers, rather than give it up, put a penalty clause in the contract that kind of slowed down the over contracting. Now, of course, practically all rice is planted by airplanes.

Crusher-Mower Equipment

Dickman: When you got through with your rice harvesting research did you go then into the seed bean injury, is that the next?

Bainer: Well, first, there was a rather fill-in project resulting from an invention. This invention was a crusher-mower developed about 1929 or '30 by E. B. Cushman who had lost control of the Cushman Engine Company in Lincoln, Nebraska. Mr. Cushman had the idea that it would be possible to crush the stems of coarse material like alfalfa and hasten the drying because there would be small cracks in the stems where the moisture could get out, rather than have to be transferred out through the leaves.

Mr. Cushman built a self-propelled, five foot cut, crusher-mower and at our invitation brought it to Davis. We set up a project with Professor Madson in agronomy as co-worker. We ran tests at Davis in June, 1930 and again in September, 1931, in which we compared the rate of moisture loss of hay, cut with the crusher-mower versus the standard mower. And the results were very revealing, in a way. It showed that the moisture loss from the crushed hay was much more rapid than from the hay cut with an ordinary mower. The difference being thirty-five to fifty percent. It appeared to me that hay might be cut early in the morning under the dry conditions of our interior valleys and actually be put up that night. Maybe this was carrying it a little too far, but it certainly could be put up the next day. The result of these early tests was published in <u>Agricultural Engineering</u> 12(5):165-166 May 1931.

Dickman: How does that compare with the more traditional?

Bainer: About half the time, I would say. We carried some more work on the next year primarily because Cushman made the deal with Food Machinery to manufacture this unit. We carried on some work in the San Fernando Valley in 1932. Mr. Gore and I did this particular job near Reseda on Frank Alvases farm. We not only compared the rate of moisture loss, but also compared the shatter losses in the field as a result of crushing versus standard method and found very little difference.

Bainer: We carried on some work at Davis again in the fall, and this whole idea looked very promising. Food Machinery took it over, and the fact that they were going ahead, we dropped out, because it appeared it was soon going to be a commercial unit. But for some reason Food Machinery wasn't very successful in developing the machine. Food Machinery has excelled in pest control, packing house and processing equipment like peach and cherry pitters, pear peelers, can cookers, etc. But for some reason or another they didn't come up with a field-worthy machine. Very little happened in this area until the patent ran out. Then several companies manufactured their version of the crusher-mower. And now it's a tremendous business. They call it "hay conditioner," in which the hay is crushed as it's mowed, and can be put up much faster, and this is very important whether its wet or dry. In a wet region you might beat the rain by being able to take it up a day early. In a dry region such as we have, you'd eliminate a lot of bleaching in the sun if you could take it up earlier. So this was a good idea that took many, many years for acceptance, and I think primarily because a real field-worthy machine was never developed until other companies got into the act.

Seed Bean Injury

Bainer: Now we will get started on the seed bean project. It started with a telephone conversation between Dr. H. A. Borthwick of the Botany department and Professor Walker. Borthwick was about as down to earth botanist as I've ever known. He was a real practicing botanist. Unfortunately the University lost him to the USDA, and he never came back. Borthwick had read two articles that criticized the quality of lima bean seed. These were written by two scientists at the University of New Jersey. It so happened that California produces much of the seed that's used elsewhere. In the New Jersey area there's lots of market gardens and they were using the seed from California. These people simply made the study in the fields of bean seedlings that were mutilated in one way or another, and they attached some real crazy names to these mutilations.

If you split a bean down the middle and open it up so that you can see the inside, you'll notice at the embryo end that there's a complete plant. You can see the root, the stem, the connection to the cotyledons and the two leaves. If this bean seedling gets a blow, there's nothing to protect that little plant but just a thin skin. If you hit it just right you can break that plant inside, without cracking the skin. And this is what was happening.

Bainer: They were planting what appeared to be damage free seed. But, they were getting some plants on which the first true leaves were missing, and they called that bald head. Another very common damage was where the two cotyledons had been broken from the stem. Those were called snake head. In some cases the stem was cracked or the root (radical) was broken. Seedlings produced from damaged seed usually grew but at a much slower rate resulting in lower yields. Sometimes disease entered the breaks killing the plants.

Well, Borthwick got interested on his own. He read those articles. They didn't even indicate in the article that this might have happened in threshing. They just simply made a study and this is what they found. So, Borthwick went to the Clarksburg area south of Sacramento, in the fall of '31 and got permission to sample a bean thresher -- baby limas being threshed. He took samples from the machine, and he also took samples from the material before it went into the machine, in other words, he hand threshed some. He brought them back and germinated them. He brought the lot of seedlings over to show Professor Walker then chairman of Ag engineering. Walker called me into his office to observe the plants. And boy, I'll tell you, you never saw so many mutilated seedlings in your life from the machine threshed samples, and none from the hand threshed sample. I came in and all of this stuff was spread out on Walkers desk. Here was a pile of perfect, undamaged seedlings from the hand threshed lot. And, there were about nine mutilations of different types that he had separated from the machine threshed lot. Borthwick said, "Gentlemen, I came over here just to tell you that the next step is an engineering study. I'll be very glad to work with the engineer that might be working on this project, but there's nothing I can do because it's very evident to me that this all happened in the machine."

So I wrote up a project, with Borthwick as a co-worker. We went to the Harris Co. in Stockton and bought a regular bean cylinder and concave and mounted it on a truck. It was operated from a power take-off on the truck. We threshed beans through this cylinder at five different cylinder speeds starting at 770 feet a minute (that's the peripheral speed at the tip of the teeth) and up to 1560 feet per minute, about a two to one range. We proceeded, then, to the bean fields that fall(1932). We had just a box to catch everything coming through. It was hand fed. A screen was used for a rough separation and a blower was used to separate beans from chaff. We operate over a range of moistures. When we came in we had a very definite correlation between cylinder speeds, moisture content and damage. The cylinder speed was definitely the offender.

Bainer: We could never get the range of moistures that we wanted in the field, and moisture was a factor. The wetter these beans were, the less apt they were to be damaged. The dry ones were brittle, just like glass. So when we were in the bean fields we were thinking about what we were going to do as a follow-up. We were not getting the range that we would like. So, we hired a kid to thresh out a hundred pounds of beans by hand. We bought them from the farmer. He thought this was silly, but we told him we wanted some absolutely damage free seed to work with.

We brought this seed back to Davis, and then we were faced with being able to subject these seeds to a known impact. How do you do it? So that everytime that seed gets an impact it's the same. Borthwick knew how to vary the moisture in these beans. A botanist, you know, can add moisture or dessicate and bring this sample down to any moisture level. You never know what prompts you to do certain things, but I took out the slide rule and calculated how far you have to drop a bean to give it a speed of 750 feet per minute.

Dickman: In a free fall?

Bainer: Free fall. Well, we found it -- two and a half feet, and to get 1560 feet a minute we only had to drop them ten and a half feet. So I went over and talked to Dr. Roessler in Physics and I told him about what we were ready to do, but we were a little concerned about how much air friction would affect us on this thing, and he said, "Just neglect it." So we made a laboratory set-up using a steel block on a frame and surrounded it with canvass to catch all the beans that bounced off the block. Then we fixed a variable height drop using a V-shaped trough, so that you could just push these beans down, and when they came to the end of the trough they dropped, so that every one started with the same zero velocity.

Well, we ran through several moisture ranges. I think we went down to as low as six or seven percent. We'd had moistures in the San Fernando Valley as low as seven percent, and they were just wrecking beans, and we ran up as high as eighteen, nineteen percent. Being able to vary the height of the fall, we could reproduce anyone of the five cylinder speeds, and by varying the moisture content, we could reproduce any moisture that was noted in the field.

Then we germinated the beans in a constant temperature room that was about eight by fifteen. It was the biggest germinator I ever saw. I think we germinated three thousand samples. Mrs. Leroy

Bainer: Hyde did the germination work. Well, sir, when we plotted all the data it just fitted right in to all the field work we'd done, and it gave us confidence, you see, in what we were doing. This was more significant than what we were doing in the field, because we had better control over everything.

Well, Borthwick was going to leave and Dr. W. W. Robbins, the head of the Botany department,was determined that Borthwick wasn't going to leave here without publishing the bean data. So apparently he called him in and said, "When are you guys going to get that Experiment Station bulletin out covering your work?" Well, Borthwick said, "I'll talk to Bainer," and he came over and talked to me and I said, "We haven't enough data to write a bulletin." When Borthwick went back and told him that Bainer thought we ought to do some more work before sticking our neck out in a bulletin, Robbins came to see me. He was very complimentary, he said, "I've never seen so much data acquired in such a short period of time and such significant data." And, he said, "you'll just have to do it." Robbins said "You know, Borthwick is leaving at the end of this fiscal year." So Borthwick and I sat down and wrote that bulletin [U.C. Agricultural Experiment Station Bulletin 580, July 1934] Well, it's been pretty much the bible for the bean growers, and even some of the seed companies have even carried it a little farther and published some of their own material. It was a very interesting experience. Some of the things that we found out in the early '30s on the beans was put to work fifteen years later and solved an entirely different problem.

It was really a short project, in a way, but we got into other problems. The problem of dropping beans, let me say, into deep bulk bins could result in velocities higher than cylinder speeds. Some of these bins are twenty to thirty feet deep and are filled with beans from the top. Zig zag slides were used to lower beans without giving excessive accelerations.

It was evident to us that the bean thresher wasn't a perfect machine, because you just couldn't operate as slow as we did. You couldn't run those cylinders as slow as seven hundred and fifty feet a minute so our next step, after Borthwick left, was to try to develop a new method of threshing without impact. J. S. Winters who was a very practical staff member who taught only non-degree courses, and had had a lot of experience with threshers became interested. So he and I wrote up another project to develop a thresher that would thresh beans without damaging them [Ag. Engineering, 18(5):205-206, May 1937]. We tried several things first. We tried running two converging belts over the same pulley. In other words, the pulleys that drove the two belts

Bainer: were separated, and one belt ran over a pulley on top and another belt ran over a pulley below. But in the middle, they both ran over the same pulley, so that one was attempting to go faster than the other one because the radius of the other pulley was varied by the thickness of the belt. That gave not only a pressure on these beans, but a little scuffing action, a little rubbing action. Well, the problem was to keep the belt on and to keep the beans from getting under the belts.

We knew that people did roll beans out with a roller on hard ground or on a threshing floor. They went in with a roller and a team, and actually drove back and forth and this pressure threshed the beans.

Next, we built up two drums using 10 inch pipe and took them to Oakland, and had a one inch layer of rubber vulcanized to them. They were mounted in a frame like a washing machine wringer. Bean straw was run through this pair of rubber covered rollers. We drove the bottom roll, but the top roll was driven by friction with the bottom roll or friction with the material passing through. There was a tendency for a little slipping between the two rolls, or between the top roll and the material that was going through on the top of the bottom roll. And much to our surprise (the beans which we were working with here were pretty dry) we could get an eighty-five percent thrash of those beans one time through that pair of rolls. Well, boy, I tell you, that was worth carrying a little further. So we ran that stuff again and got about eighty-five percent of what was left, and by re-running it three times, we were getting maybe ninety-five percent or so of the beans that were there.

Well, our next move was to build a self propelled thresher. We built the machine in our shop, using three pairs of rolls with straw walkers between each pair, so that the material passing through the rolls was bounced up and down before entering the next set of rolls. The shaking of the straw caused the free beans to fall through the straw rack onto a cleaning shoe. The beans that were threshed were separated from the straw between the sets of rolls. They didn't go through the second set of rolls. The same action took place between the second and third set of rolls.

We worked on windrows of beans. You see, the cut beans are windrowed for curing. You have to do that. You don't thresh beans like you do wheat.

Bainer: When the machine was finished, we barn-stormed the state with it. We worked in Orange and Ventura Counties, the San Fernando and San Joaquin Valleys, then went up to Marysville where red kidney beans were produced. We felt that this was a good approach toward this problem of seed bean threshing. There was only one manufacturer of bean threshers in the state at that time. He built a two cylinder machine, and he did the same thing we did, by running the front cylinder as slow as you could, and separating the threshed beans before the material went through the second cylinder. He came the nearest of doing the job, but he still was damaging a lot of beans.

So finally -- his name was Collin B. Hay -- we got him interested enough to come out and take a look when we were in the San Joaquin Valley. After he saw the machine he followed it the rest of the season.

The machine worked quite well under dry conditions. However, along the coast where the straw was damp, it was impossible to get a clean thresh. Those that were threshed were free of damage. We got perfect beans out of the straw but we were still leaving five or ten percent in the straw.

We were driving all three of the bottom rolls with the same chain, so they all went the same speed. The top rolls were driven normally in contact with the lower rolls, or in contact with the bean straw passing between. Well, we put sprockets on the top rolls. The sprockets between the first and the second rolls had one tooth difference. So, a ten tooth sprocket was used on the first roll, and a nine tooth sprocket on the second roll. That meant that the front roll was always trying to accelerate the second because it had a ratio of ten to nine. We did the same thing between the second roll and the third roll. So this differential speed gave a considerable amount of scrubbing action and that improved threshing.

The first order for a rubber roll bean thrasher came from a group of kidney bean growers in the Yuba City-Marysville area. They were having an awful time, because the kidney bean was a rather long bean, and very subject to damage, much more so than a lima, which was more compact. They finally persuaded C. B. Hay (and I helped, I went down to San Jose several times to try to get C. B. Hay to give a price). He finally told them that he would build that machine for them that would be thirty-six inches wide (ours was only eighteen inches wide); he'd build it for them for cost plus ten percent, which was a good arrangement, but they had to be content with whatever he came up with. He wasn't going to guarantee it. Well, sir, he got that machine built, and got

Bainer: so fascinated with it that he went up there and tried to buy the contract back from those growers so that he could have a whole year to study the machine. Well boy, they needed the machine and they said, "Nothing doing. We made an honest out and out right deal with you." He even raised his ante. He offered them two thousand dollars if they didn't buy the machine! And, as I say, they wouldn't. So he lived up to his contract and delivered the machine.

Well, we all made one mistake. It came up later, and I don't know why C. B. Hay didn't think about it, or why Winters or I didn't think about it. Hay finally built machines up to forty-eight inches wide. Great big machines. And, he sold some of them to seed companies. Ferry-Morse at Salinas bought two of them. Associated Seed Company bought one at Milpitas. And Ferry-Morse (this was now war time) was in the radish seed business, and I mean in a big way. You know, every victory garden had radishes, and boy, they sold tons and tons of seed. They just had hundreds of acres of radish. And, it was a problem to thresh this stuff. So they put the bean thrasher to work in radish. And, it was a natural. It threshed this radish, but it still left five or ten percent in the pods, and then they did the smartest thing. We all should have thought of it. (This is one time I'd have liked to kick myself around the block). They took out that last set of rolls and put in a clover huller and concave cylinder in their place. That gave a real rubbing action. Because five to ten percent of the seed was part of the profit they wanted all of it. By running it through two sets of rolls they got out ninety percent damage-free radish seed, and then when it went through the metal cylinder, and concave, they got the rest of it out and while they did some damage to it, it was such a small fraction it didn't amount to very much in the total sample.

Dickman: Is that what they're using today?

Bainer: Hay sold his company, and the man that bought it was interested in building the machine. However, he was killed in an airplane accident the first year that he owned this company. The new fellows that bought it never showed any interest in the machine so they went back to building the two cylinder steel machine; so here was an idea that I think was a world beater for beans and radishes, especially for beans, and I think if we had had enough gumption to put a regular standard bean cylinder concave at the third position in that machine using two pairs of rolls and a clean-up cylinder, there'd have been no criticism. But a farmer that sees this machine thinks "How am I going to get that other five percent?" He didn't realize that he was producing bean seed that was so far superior to anything else that he could get, germination wise, but these are hard things to understand.

Bainer: I think the most interesting use of this machine happened one day; Don Porter, who used to be here in vegetable crops (and went with Campbell Soup) and I were invited to a seed meeting in Santa Barbara. Porter had been in contact with Gilbert Scott, who was with the Associated Seed Company, who had also been here in vegetable crops, Porter told him "We'll drive down to Milpitas and pick you up and we'll all drive down to Santa Barbara together."

So, when we got down to Milpitas, Scottie was still working. He didn't expect us so soon. He said, "Well, I can't go for a few minutes. I've got some threshing I've got to do here." (They were running a little late with their work.) I remember Porter saying, "What are you going to thresh?" He said, "I've got fifty lots of beans to thresh." Porter said, "Well, we'd better go on. You come down tomorrow or the next day." Well, Scottie said, "It isn't going to take very long to thresh these lots of beans."

Well sir, these were little rod row tests. He had harvested each one of these rows, and put them in separate burlap bags and tied them up. So he had fifty of them, and he just successively threw those bags in the front end of that rubber roll thresher and threshed the beans inside the bags. I think he put them through a couple of times, and it did a beautiful job of threshing, and also, there was absolutely no way of getting any mixtures, you see. These were different varieties, and he couldn't stand any mixtures. Well, he said, "We always get mixtures any way we handle them," but here was a way; he just kept them all in the same bag all the way through the threshing. So, as I say, that just capped the climax on the bean thresher.

Flax Seed Threshing

Dickman: You've done research in flax seed threshing. Could you talk about it, please?

Bainer: Well, my connection with this was limited; I don't want to leave the impression that I was responsible for this project, which was really the responsibility of J. P. Fairbank and J. S. Winters. And it came about back in the early '30s at a time when a new variety of flax had been introduced through the Imperial Valley Experiment Station to California. This variety was known as "Punjab," and was an introduction by the U.S. Department of Agriculture from India. I'm told about two ounces of the seed was

Bainer: sent to Mr. L. E. Gore who was superintendent of the Imperial Valley Experiment Station in El Centro.

Gore planted this seed in a small plot, and when he harvested it and reported the yield to Washington, they didn't believe him. They actually accused him of mis-weighing the seed or mis-measuring the size of the plot. They said you couldn't have a yield anywhere near what he had reported -- which was in the vicinity of fifty bushels to the acre.

Dickman: Compared to what --

Bainer: Well, normal in the Dakotas where we grew flax in a limited way -- see, flax had never been an important crop in the United States, but in the Dakotas, the flax did very well if it yielded seven bushels an acre, and here was seven times as much as you normally get. This provoked Mr. Gore because he was a very careful man. He rechecked his figures and they were right, but they just said, "Please repeat the test another year."

In the second year, you can be assured that Mr. Gore really took care of his flax. He didn't baby it along in the first planting, but he certainly did in the second. In the second year it out-yielded the first year crop. So, there wasn't any doubt in people's mind that here was something that was fantastic as far as flax yields were concerned.

The problem was, there wasn't anything to thresh it with. I mean, you could thresh it, but you had a problem of separating the flax seed from the straw. The conventional machines with the spike tooth cylinders tore the flax straw up and pulled it apart. It's a very fibrous material, and sometimes you have almost what's the equivalent of a big ball of yarn back in the separator, and the flax seed just didn't sift through it. So that it was evident that some other method of threshing was needed.

About the same time that this flax came into California, the patent rights on the rasp-bar cylinder, which was owned by Massy-Harris, expired. And the Rasp-bar cylinder was more of a universal type of cylinder that could be used for a lot of crops not adaptable to a peg tooth or a spike tooth cylinder. The rasp-bar cylinder was introduced in machines in California in 1931. But still, this flax seed was very susceptible to injury, and if you cracked a flax seed in the threshing process, by the time it got to the mill, the oil was oxidized and lost.

Well, we mentioned Waldo Weeth earlier; he was a student at Davis who went to Imperial Valley and succeeded Gore when Gore was

Bainer: brought to Davis. And Waldo got interested in flax threshing. He mounted a pair of rubber covered rolls across the front of the header platform with the idea that as the flax was cut and introduced into the machine, it would pass between the rolls and the bolls, which contained the flax seed, would be crushed and that would liberate the seed, and you wouldn't have to work so hard on it in the machine.

Well, this was kind of an awkward arrangement. When Fairbanks and Winters got into this picture, there were one or two companies that conceived the idea of putting a pair of rolls either ahead or behind the cylinder. (I don't know why anybody thought behind the cylinder was where the rolls should be placed. They belonged in front of the cylinder.) These two rolls, one was rubber covered and the other steel. The top roll (rubber covered) ran ten percent faster than the bottom roll, so there was scuffing action as well as the crushing action. There were stops on these rolls so that they didn't come together. There was always enough room between the rolls so that the seed wasn't crushed. The idea was just simply to break the bolls. Now, the flax plant has seeds carried in bolls at the ends of the stems, and all you need to do is break those bolls, and liberate the seed, and the less work you do on the straw, the better.

And so, that first year they tried two or three machines with the rolls. The next year I think there were six or seven companies that had combines in the Imperial Valley and all of them had rolls. And so, it was a short term experiment in which the rolls proved to be very effective in breaking the seed bolls, and they just simply used the cylinder and concave(Rasp-bar cylinders or angle bar cylinders) to agitate the straw to insure that the seed was liberated. And the straw was then carried out of the machine on the straw racks and the seed fell through. They could thresh the seed without damage, and also had a market for the straw.

The straw was eventually purchased by paper companies and was the source of cigarette paper. They didn't want this straw torn up, they wanted to work on this straw themselves, so that this was kind of a by-product.

Well, the only other experience, and this was a personal experience, happened about ten years ago in flax. A new variety of flax was introduced from the Brawley Station (USDA) in the Imperial Valley, a selection, or a cross between "Punjab" and something else -- I don't know what the source was. This flax was introduced as New River flax, named for the river formed by the flood

Bainer: in Imperial Valley in 1906. I don't know the background of this development, but apparently they hadn't had too much experience in commercial threshing of this new variety. It came into use because of its improved oil quality and also yield. One day Paul Knowles of the Agronomy Department, who's responsible for oil seed crops, called me and said they were having an awful time in Imperial Valley with this New River variety of flax. He called at the end of June after threshing flax had started. He wondered if someone could go down there and look into this problem. I said, "Well, I just didn't know. I would canvass our group." And I talked to John Goss who was working on small seed legumes and he didn't have time to go.

Well, to make a long story short, I told Knowles I'd go down for one week. And when I decided to go for one week, Goss decided to go with me. So we loaded up and started out on a week-end, and finally got down there. The second day Goss became very ill. We had to fly him out of the Valley and that left me there by myself. One of the fortunate things that happened was that the John Deere dealer in El Centro had what we know as a set of soy bean sprockets for the combine he sold. These soy bean sprockets provide for slowing the cylinder, but maintain the speed of the rest of the machine so that the separation was done normally, but you could slow the cylinders down twenty-five percent or so, and still maintain the cleaning and separating speed.

So we got these sprockets and installed them and that pulled the speed down below where we normally operated for flax. (You'd normally operate for flax about half what you do for wheat, for example, and this even brought it down below that.) In one week's time, with the good fortune of being able to slow these cylinders, which we knew we had to do, from our previous experience with flax and beans, we were able to correct that situation. It always amazed me how reluctant we were to go down there, and then to go down there and run into this kind of luck, and be able to go down there and correct this situation.

During this particular period the weather was influenced by winds off the Gulf of Lower California resulting in high humidity. I never thought I'd ever see the time when you couldn't thresh when it was a hundred and ten degrees. But the humidity was so high, and the flax straw was so tough, that you couldn't open the bolls. You had to wait until the humidity dropped which was well into the afternoon.

When they get east winds, they're dry, and sometimes you can hardly measure any humidity. Under these conditions the flax hulls pick up a static charge. They stick to everything, and

Bainer: build up inside of the machine to the point where you can't separate the seeds from the hulls. These extremes present a real challenge to anybody developing machinery. Anyway this was an interesting experience. (There's some flax grown, but not as much as there was for a while. I suppose it's a matter of market for the seed. It all goes into linseed oil production.)

I remember one time I was having lunch with Dr. Edward Teller at the time we were having trouble with flax threshing in Imperial Valley. I mentioned that under certain weather conditions when the humidity dropped to practically zero that the hulls of the flax boll would pick up a static charge and stick to the inside of the machines and affect the separation of the flax seed from the hulls. Teller had an immediate answer: I'm sure it probably would have worked. (Now, whether we could have found a material that would have been safe to use, that's something else.) He suggested that we paint the screens and the inside of the machine with a radio-active isotope paint that would neutralize the charge. As I say [laughter], he was right on the ball.

Dickman: Might have given you a little radio active flax.

Bainer: Well, he thought there could be a material that would be weak enough so it wouldn't bother.

Mower Attachments to Cut Vetch

Bainer: Another rather interesting experience that we had at Davis in the '30s was a request for developing a simple harvesting system for purple vetch. Vetch had been substituted for alfalfa at several locations in the San Joaquin Valley. It was grown regularly on the coast. At the time vetch was introduced as a forage crop, the alfalfa had been hit with wilt. We felt that the introduction or substitution of the vetch for the alfalfa was only a temporary measure, because certainly plant breeders could come up with a wilt resistant variety (which they did later on).

Well, vetch was a real tough crop to mow, and this was just a mowing job. Jim Fairbank, who was our extension engineer, had been working with some of the farm advisors, and practically told them "You just go ahead and let your farmers plant vetch and next spring we'll have something to cut it with." And [laughter] of course Jim comes around and enlists some of us to work with him to try to develop something that could be used to cut vetch. I

Bainer: think the best example of how vetch behaves came as a result of a little conversation with Mr. Gore (who used to be at Imperial Valley but was here at Davis working vetch at this time). A farmer had asked him what he should grow in place of the alfalfa that he could no longer grow. Gore told him, "Well, why don't you try purple vetch?" Well, the farmer said, "Yes, Mr. Gore, it seems like it would be a reasonable crop. My neighbor had forty acres of it last spring, and I went down there and I took ahold of one corner of that forty acres and I shook it, and the whole forty acres shook. It was all tied together in a mat. How in the world are you ever going to harvest it? If you can tell me how to harvest it, I'll grow the crop."

This vetch plant has runners or tendrils that are maybe six, eight, ten feet long, and they grow in every direction. And when you consider that you've got a mat of material on the ground maybe two feet thick made up of these tendrils running in every direction, you've got a jungle to get into. What Gore tried to do, and did do partially successfully, was to plant oats with the vetch (about 15% oats and 85% vetch). The oats were supposed to grow up and give support for the vetch to climb up and keep off the ground. Well, this was a beautiful partial solution, but the year when we really had to do the job, we had had a rough winter which killed all the oats. So here was nothing but the purple vetch.

Well, we built -- remodeled or remade, actually -- some mower cutter bars. We had a couple of machines rigged up so that we could try them out. Agronomy planted some vetch for us to work in. But we ran through this in short order. And then Agronomy had some vetch on the university farm, but they couldn't let us in this vetch until after Agronomy Day, because they wanted to show farmers what they were growing. And so we were kind of stuck for a place to work, even though we had a lot of innovations on the cutter-bars.

About that time, one of the field managers from El Soyo Ranch, down near Modesto, dropped in and said, "You know, I very foolishly planted a hundred thirty-five acres of vetch, and I have no idea how I'm going to harvest it. What do you fellows suggest?" I said, "Well, I'll show you what we have, but we haven't any vetch to get into to try it. We have stub guards and lifters over the guards on these mowers, we have a special outer divider to separate the cut from the uncut vetch, and so forth." He took a look at these two machines that we had rigged up. He said, "Listen, just load these up on the truck and I'll meet you at El Soyo Ranch in the morning. We'll give you two teams and two

Bainer: drivers (these were still horse drawn mowers) and a blacksmith. He'll make any changes needed. And we'll put you up in our dormitory and feed you. It won't cost the University one cent for you to come down there, and you'll have one hundred and thirty-five acres to work on."

So we loaded up. I tell you, we were getting desperate. We loaded up, and by golly, some of the combinations started working, and the main thing was to have lifters about every foot on the mower which would lift this mat up over the cutter bar. And then using stub guards in between, so vetch wouldn't hair pin on the guard point, an underserrated knife which had a roughness which would catch the vetch and hold it while being cut. And then we made a separation at the outer end of the cut swath from the uncut. This was done rather cleverly without anymore than what we called a goose neck divider, and by George, you know, the thing is that it worked.

Well, Jim Fairbank arranged a barnstorming trip through the vetch growing area of the San Joaquin Valley, and every day we put on a demonstration. We also modified the farmer's mower while we were putting on the demonstration (we took a mechanic along), so when we left, we left him with a mower that would mow his vetch. I think I had more fun out of that for just a matter of a few days, an extension trip demonstrating this, you see.

I remember going to a dairy farm in Merced County, unfortunately I can't remember the name. This young fellow had taken over the operation of the dairy from his father. His father was still there, and one of the jobs the father had was to mow a little vetch every day for cow feed. The father was getting along in years. He came over to the truck and said, "Son, what do these fellows have here?" He said, "Well, they've got a couple of mowers to put on a vetch cutting demonstration." He said, "Son, tell them not to unload. No use taking this mower off the truck -- vetch just can't be cut with a machine." Well, we unloaded. He said to his dad, "Oh, come on. We're going to have a demonstration." So they put the old man on the mower. They had been trying to cut this stuff blind. They didn't make any separation of the cut swath from the uncut. He made a round, he made two rounds. We couldn't get him off the mower until he mowed the whole goldarned field. It was the funniest thing I ever saw. [Laughter] He came in to his son, and said, "Son, we just went at this thing backwards. We were trying to separate after we cut the swath, and these guys separated the swath when they cut it."

Well, it was about the simplest gadgetry, and I call it gadgetry, that I've ever been involved in and about the quickest solution

Bainer: to what seemed like an unsurmountable problem. About the time we got everyone equipped to grow vetch [See Attachments for Mowers to Cut Vetch, UC Ag Ext Service Information Series #6 May 1934].

Dickman: They got alfalfa --?

Bainer: Yes, they got a new resistant alfalfa and quit growing vetch. Yet, if you can visualize a crop that in one cutting would give you more than five tons of hay you had quite a crop. Contrast this to alfalfa that's all standing erect, if you get one or one and a half tons in one cutting it's pretty good alfalfa. And yet this darned vetch would run as much as five or six tons in one cutting.

Dickman: Is alfalfa that much better as feed?

Bainer: Oh, I wouldn't say it isn't any better but it's lot less problem to grow, and of course, vetch had to be planted every year. Alfalfa is a perennial and you get 5 or 6 crops a year. But they still grow vetch over in Sonoma County, over along the coast without irrigation, but the yields are not large.

Rural Fire Fighting Equipment Tests

Dickman: Well now, you had some experience fighting fires, too.

Bainer: Yes. Jim Fairbank, who was our extension engineer, and the only one we had at that time, served the whole state of California. He was a great fellow to come in with problems, and a great fellow to enlist the support of other people, anyone he could get to work with him. The fact is that when I came here in 1929, Professor Walker thought one of the best ways for me to get a bird's eye view of Northern California was to go out with Jim Fairbank for a week or so on an extension trip. Jim Fairbank was making a survey of rural fire fighting equipment over the northern part of the state, and this gave me a chance to get acquainted with Jim and to see this area. And, I suppose Jim liked it because he got me more or less excited about some of the problems involved in rural fire fighting equipment.

One of the problems concerned tankers; rural fire fighting was all done by tanker trucks, and there had to be re-fill stations where they could get water very rapidly in case of a fire. They had problems with the hose -- you see, in city fire departments

Bainer: there are big water hydrants that take a three inch hose -- well, you don't have that kind of water when you're hauling it in a tank, and yet you've got to have something that's durable and can be handled.

So they came out with a smaller fire hose, and I'm talking about a rubber lined, cotton jacketed fire hose that you see with any fire truck. These were brought out in sizes of one inch and an inch and a half, -- real small compared with the city. There was nothing known about the characteristics of this hose, friction losses and the like. So, Kenneth R. Frost (I think he was a graduate student at the time) got interested in running some friction losses on rural fire fighting hose, and I was his instructor, so we worked together on the thing and came out with a series of curves to show the losses and the effect of elbows and different fittings, and the like.

Well, this was published [Tests on Hose for Fighting Rural Fires. Ag. Engineering, 12(5):171-172, May 1931] and whether it did any good or not, at least people knew how much loss they were going to have in those hose lines.

Then another rather important problem was presented, and that is, when you're fighting a fire in the forest or in the mountains, and you have a source of water to replenish that which you used from the tank, but this source may be thirty or forty or fifty feet below a bridge; how do you get this water in the tank from that distance. Of course, it is below the limit of a suction type pump.

Dickman: Which is what, thirty-three feet?

Bainer: Yes, thirty-three feet theoretically; 15 or 20 feet practically. We were familiar with the injector type pump, which is an energizing device in which you have a nozzle that discharges into the throat of a venturi tube, and if you put water through this nozzle under pressure(150 psi) and discharge it into the throat of the venturi tube, you can create a partial vacuum which would pull water into the venturi tube, and that water then would be mixed with a high velocity water which would energize the inflowing water. The transfer of energy can be used to lift from a distance of oh, fifty feet, if you wanted to. So, it meant that you had to have two hose lines to go down from the bridge, a one inch line to the nozzle, and the other, which would be the return line, would be an inch and a half. And at the bottom of these two hose lines would be the injector type pump which had the nozzle that was connected to the one inch line and the venturi which was connected to the inch and half hose line. And there

Bainer: would be a strainer to keep any foreign material out. You always had to be sure that you had enough water in the tank to fill the hose line down to the injector, and you had to connect this to the pump on the truck. And so you forced the water down, energize water in the exchange between the nozzle and the venturi, which brought water up to the surface.

Well, we worked with Mr. Jacuzzi, one of the manufacturers of this type of pump for quite a while. He couldn't come up with the combination, a ratio between the venturi and the nozzle that would accomplish just exactly what we wanted. And finally I picked up the design factors, that he was using in his calculations. So I actually designed a ratio, and the next time he came up I told him how I'd used his information to design the thing and he finally agreed that this was fine.

So he built an injector pump, and I ran tests in the laboratory, and couldn't believe that the efficiency of this thing was going to be so low. I think the over-all mechanical efficiency of this pump was only ten or fifteen percent -- maybe twenty. But that wasn't important. What was important was to get some water. We had plenty of power and pump capacity on the fire truck. We could load four hundred gallons into the tank in ten minutes from 50 feet below the bridge. This was a lot better than having to drive fifteen or twenty miles just to get a load of water and then back. I mentioned the low efficiency to this gentleman from the company, and he said, "Who gives a darn about efficiency except engineers, anyway?"

Well, anyway this pump is still used for domestic purposes, but not in large sizes. I mean efficiency on a one horse job or something like that isn't too serious, I suppose. Well, I think two payoffs came on this development. One, Fairbank felt we ought to demonstrate this thing to the forestry people in Sacramento, so a demonstration was arranged out on the Fair Oaks Bridge across the American River. This bridge was fifty-two feet above water level. We had the forestry people bring a tanker truck out on the bridge. The only unfortunate thing was that it was just foggier than the dickens. I was afraid someone was going to get killed on that bridge. We were stopped out in the middle. We had people directing traffic.

By the time the forestry officials came out we had rigged up the two lines down to the injector pump and were pumping water. These guys looked over and saw this stream of water coming into the tank (we were filling the tank on the tanker), and I don't know what they thought. They knew it was beyond the suction level of the pump, and there we were lifting water fifty-two feet. This

Bainer: immediately appealed to the forestry people who had a lot of these tankers. And I think that next winter we put on a demonstration down in UCLA at a fire fighting conference. We managed to get a truck up on a bluff above a canyon road and we had another truck down below. And it was a hundred feet vertically. We dropped the hoses from the truck above to the tank in the truck below, and we pumped the water out of this truck into the one above. It was just like these people were seeing something they didn't believe, you know. Well, there wasn't anything magic about it [laughter], it was just a matter of applying another principle. So there was the principle of the injector pump that was introduced into this rural fire fighting scheme. It was very useful, as I say, when you could run down to a bridge and pick up water from fifty feet, where you might have to drive fifteen or twenty miles for a supply of water.

Spark Arresters for Motorized Equipment

Bainer: Well, the third phase of this thing came as a result of the legislative action in 1931. An ordinance was passed that made it compulsory to equip internal combustion engines with spark arresting devices, where they were being used under hazardous conditions. The state officials came to Mr. Fairbank, who was a specialist in rural fire fighting and asked him for a list of adequate devices that were capable of stopping hot carbon particles coming from the exhaust of internal combustion engines. Well, there weren't any.

The first thing I knew, I was mixed up in study of spark arresters. We felt that it was necessary to start some fires with hot carbon particles in order to determine the minimum size of a carbon particle that was dangerous. We felt that below a certain size the particles would cool while falling to the ground and would not start fires. But, we needed this information.

We spent a couple of summers starting fires under different climatic conditions in grass, barley stubble and forest cover. When the humidity got up to a certain point you couldn't start a fire. However, there were days when we had north winds around here when the relative humidity dropped down to ten, or twelve percent, and the temperature was a hundred and ten degrees, and fires were instantaneous. I never saw anything start so fast. One situation, in the forest, could have been disastrous. We shot some hot carbon particles into punky wood, and fortunately, the forest service had left a ranger there after we left. And

Bainer: that thing was smoldering (of course, that's why they left the ranger there), and an hour later, it broke out in a fire. This led us to believe that a logging tractor could be three or four miles down the road before a fire developed and no one could blame him; that fire just started on its own, you see.

It was evident to us (all this is published) ["Spark Arresters for Motorized Equipment," U.C. Ag. Experiment Station Bulletin 577, July '34] that we had to do something to improve, or come up with a new idea that would arrest carbon particles emitted by these engines. There were some, so-called, spark arresters on the market. One was made years and years ago, patented, by Yuba Manufacturing Company who had built this spark arrester for the Yuba Ball Tread Tractor. We acquired one of those arresters (I don't know where we got it because they weren't manufactured anymore, but we found one).

We started out first operating at night with a tractor under load. We developed a venturi in the exhaust system which made it possible to introduce hot carbon, incandescent carbon, into the exhaust line, and then have the exhaust pick it up and throw it out. And this was another application of that venturi injector type thing, and it worked very well. There was enough vacuum created in that throat to pull the material in, and then of course, the exhaust gasses would mix with it and kick it out. Well, we ran these tests at night, and usually on dark nights so we didn't have the moonlight to bother with. We installed one of the Yuba arresters on a tractor and I was standing up on top of the tractor looking into the spark arrester, and I could see the carbon particles bounce against the central tube wall and out of the arrester. The central tube was about four inches in diameter that led from the exhaust line up about half way through the outer case (8 inches in diameter). The outer case had a restricted discharge opening in the top to remove collected carbon. In this central tube was a spiral casting which whirled the exhaust gases when they came up from the engine. The idea was, the heavier materials would be thrown by centrifugal force to the outside and collected in this outer case, and the exhaust gasses, free of this material, would be exhausted out the top. This would have been a world beater, except that they mounted the spiral down in that tube about two inches. And, what happened was the carbon particles would be whirled by this spiral and hit the central tube above the spiral and ricochet right out the top of that opening in the outer case.

So, I tell you [laughter], it was just like discovering something. I came down and I said, 'I can make this arrester practically a

Bainer: hundred percent effective. All I've got to do is move the top of that central spiral flush with the top of the innertube; so we jerked it off and moved the central spiral up so that it was flush with the top of that central tube, and then we made a new outer case that was two inches longer, so that the relationship was still exactly the same between the spiral and the discharge. When the carbon particles came off of the spiral, they couldn't ricochet out.

This change increased the efficiency of this spark arrester from sixty-five percent to ninety-five percent. And, fortunately, the company still existed and we could get this thing manufactured. I heard afterward that the company tried to get a patent on our change, as an improvement, but they didn't succeed because we'd published sketches of the change in University Bulletin #577. We weren't interested in a patent. It was before the University had a Patent Board. I suppose today we'd have had to get a patent on it, and we probably could have.

There were other arresters developed, but there was only one available commercially. And now, the Australians have a modified Yuba spark arrester. They just published the results of some tests run at the University at Melbourne. And of course they quoted our Bulletin, and so forth, but they called it the modified Yuba, and that's what we called it, the modified Yuba spark arrester.

Well, we still have a problem in California, and I thought I was going to get involved in it, but so far nothing has happened. The forest service is still concerned about fires along the railroad. And just before I went to Brazil in 1969 on a consulting trip, they asked me if I would consult for them and work on this problem of the spark arresting on diesel locomotives. Now, I'm confident that the idea of this modified Yuba arrester, which had very little back pressure, can be adapted to diesel locomotives. It isn't very often they start a fire, but there are times when they will.

Now, there was one other piece of literature. (Jim and I tried to review everything that had been done on setting fires with hot carbon particles). This book had been written for the American Railroad Association who had hired a consultant (Lew Wallace) to go out and study the possibilities of setting fires with hot cinders that used to come from coal burning locomotives. This book gave the results of many tests, all were negative. Well, when you looked close, you found that every test was run on a low temperature, high humidity day, and you'd never expect to set any fires. [Laughter] He was honest. He reported the

Bainer: results, but they were done under the wrong weather conditions.

When I was a kid farming in western Kansas I operated along the railroad. I've seen more fires started from those old coal burning locomotives on the Missouri Pacific than you can shake a stick at. I've seen fires start in the field where I was working, when these trains went by. I've even seen fires started from the exhaust of a tractor right in the middle of threshing crew. One time I was belted up to a stationary thresher, and I suddenly looked down and the stubble was on fire. Well, there was only one way it could catch on fire, and that was hot carbon particles from the engine. So, it can happen. You can start a fire from hot carbon particles, and they do come from internal combustion engines. But they can be arrested. I don't know how much the law is enforced, but I felt that probably we might get involved in law suits, you see, because a fire would start and the guy couldn't prove that he had adequate spark arresters; but so far, no.

The Amazing Internal Combustion Nut Cracker

Bainer: Another development that came along in the '30s was a result of a request from the Walnut Grower's Association. It was an internal combustion nut cracker. It probably shouldn't be called that, but it seemed to be the most logical term to apply. This came as a result of pressure from the walnut growers who were cracking about thirty-five or forty percent of the California walnut crop. The separation of the meat from the shells was a tedious hand operation. They came to Professor Walker and asked us to work on an improved nut cracker. I visited the Growers cracking rooms in Los Angeles. I found some rather crude cracking equipment consisting of a jaw type crusher that was mounted in the form of a V, with one side of the V stationary, and the other side of the V, actuated by a cam which moved, oh, about the equivalent of the space that was available between the shell and the meat of the walnut. As you know, the walnut has space inside between the shell and the meat when it finally dries.

Several of us got interested in this nut cracking idea and we tried several different methods. One day Professor Walker made the comment, "I imagine that every conceivable method of cracking that walnut from the outside has been tried. Maybe we ought to think of reversing that process and crack it from the inside."

Bainer: Well, this was certainly a germ of an idea. We had a machinist in our shop by the name of Frank Hall. And Frank Hall got to thinking about this, the same as I, and one night he came out to my house after dinner and we sat there and talked and he said, "Why can't we pull this shell off by creating a vacuum?" I told him that the maximum pressure you get in a perfect vacuum would be 14.7 pounds per square inch and that wasn't going to break any walnut shell. And then he said, "How about putting these walnuts in a container and pumping this container up so that you've got pressure inside and then suddenly open the container so that the pressure inside the nut would then blow the shell off. I told him I still didn't think there'd be enough pressure; all we had was 150 pounds of air pressure and that, I didn't think, would do it.

Well, he wasn't going to take no for an answer. So he actually built a little container, that didn't take a lot of time. And while he was working on that, Art Leonard, of orchard heater fame who had developed the return stack heater, came along, and we were talking about this problem. He said, "Well, couldn't you just fill one of these walnuts with gas; an explosive mixture, and blow it up?" One of the shop men was welding with an acetalene-oxygen torch, and we told him that we were going to saw a hole through the shell of a walnut, and we wanted him to snuff out the flame and put the torch over the nut, to fill it with a mixture of acetylene and oxygen, just in the same proportions as he was welding with. We felt that that would be within the range of an explosive mixture. So we took a hacksaw and cut a slot in the nut and he snuffed out the flame and filled it with gas and pulled his torch away. We lighted a match and it sounded like a shotgun had gone off in that shop and the shells blew all over creation, and here were the two halves of the walnut laying right on the table. [Laughter] And I tell you, that was the birth of an idea if I ever saw one. You had the idea; it was now a matter of doing this thing mechanically. So Charlie Barbee, another man who should be mentioned, was our shop superintendent. He was another Washington State product, so we had three from there. He came in with Fairbank and Stirnimán and took over our research shop as more or less superintendent. Charlie was a very ingenious individual, and while he was responsible for the shop activities he still had lots of good ideas and worked with different people on projects.

So Charlie and I started out to build a nut cracker. We mounted a couple of rubber belts on pulleys on vertical shafts. These two belts moved together, and they would convey a walnut. I mean, if you fed the walnut in between the belts, the belts then carried the walnut over a little slitting saw, which was set through the

Bainer: saw table just far enough to make a hole through the shell but not cut into the meat. And then, there was a rib on which the nut rode as it moved along with the belt. The rib filled the saw cut. We drilled a couple of small openings through the rib that would let the gas in. So as the walnut moved along the rib it came past those gas apertures and received a shot of gas and then at the other end dropped through a sheet of flame and exploded. It demonstrated it could be done.

We ran quite a few tests and the walnut growers sent us several sacks of walnuts to test and I took them back for analysis after cracking them, and it looked like a good idea. One of the problems with our particular unit was that once in a while you got a flashback between the belts clear back to the source of the gas. And boy [laughter] I'm telling you, that was like a machine gun when that thing went off! There had to be some simpler method worked out.

About that time Professor Walker had hired a young man by the name of Hayden Gordon to do some development work, and Hayden Gordon took this idea and built a very ingenious device for feeding the walnuts and holding them, effecting about an eighty-five percent separation of the shells from the meats at the time of the explosion. It looked like a cream separator at the final stages, with eighty-five percent of the walnut meats and fifteen percent of the shells coming out one spout, and eighty-five percent of the shells and fifteen percent of the meats coming out of the other. We still had a little handwork to do, but it was a tremendous separation.

Well, this was a world beater of an idea, but unfortunately it was never taken up by the walnut growers. I think one of the reasons was, they sent us some old walnuts that had been in storage probably two or three years. They had blistered a little bit, and when this explosion hit that covering of the meat where there was a blister, it just ripped the skin off and it looked like there had been worm damage. Some of the skin had been removed, although this was not the case with the fresh walnuts. We had plenty of evidence.

I understand probably the reason they didn't accept the internal combustion nut cracker was the fact that a man in Portland, Oregon came out with a high potential cracking device.

Dickman: Using electrodes?

Bainer: Yes, using electrodes. The same idea of lightning striking a dry pole. Anybody who's lived in the middle west has seen poles

Bainer: shattered from top to bottom with a stroke of lightning. It wasn't a good conductor, but it was enough that the lightning hit it and just ripped it all to pieces. It was still a noisy method, but it was clean, you didn't have gasses and some dangers that would probably be involved. But the nut cracker has served a good purpose.

Dickman: Before you get to that, it occurs to me that the nut cracker has a lesson for anyone with a problem to solve. You usually keep working at a problem the same old way, but if you can take a step back and objectively see it from another angle, it's amazing how new solutions come to you. I think the nut cracker story is a classic example of a new look at an old problem.

Bainer: That's right. There's no question about it. I don't know whether we'd gotten on it as fast as we did except that Professor Walker said let's crack these things from the inside.

A MAJOR RESEARCH PROJECT: SUGAR BEETS

Dickman: Did this nutcracker research lead to more important projects?

Bainer: Yes. In 1938 we were still working on the nut cracker; Professor Walker was East and he was contacted by someone of the U.S. Beet Sugar Association. The U.S. Beet Sugar Association was an association of all the beet sugar companies in the United States, and they worked together on major problems. For instance, to name one, they had curly top disease that practically wiped out sugar beet production in certain areas of the United States. They were more or less responsible for putting the pressure on the United States Department of Agriculture to come up with a sugar beet that was resistant to curly top. And they learned to work together, I suppose, in the sugar lobby in Washington. They saw the handwriting on the wall way back in 1938, that they had better get started and do some work on sugar beet mechanization.

Dickman: What was the labor situation at that time?

Bainer: Well, there was plenty of labor and it wasn't too expensive. These companies individually had been working in this area for years. In 1910, Great Western offered a prize of ten thousand dollars for a satisfactory beet harvester. There were many, many entries in this contest, even from Europe. We were loaned a photograph album of all those entries and all the ideas, and I'll tell you, they covered the waterfront. People were dreaming about sugar beet mechanization way back in the early part of the century, and actually it was pretty hard to see anything that was going to be brand new. It might be a combination of a lot of things, but anyway, they finally decided they would prorate the cost of a project on mechanization to the various companies in proportion to their slicing capacity, the number of tons that each one of them sliced. That made Great Western at Denver the big contributor because they sliced, I think, about forty-two percent of all the beets in the United States. They had plants in Montana, Wyoming, Colorado and Nebraska. And this group decided that it would set up a committee to determine where this work should be done. They had eighty thousand dollars to start with. And I'll tell you, eighty thousand bucks was a lot of money in the late thirties. It isn't much now, but in the late thirties it was a lot of money.

Roy Bainer in Sugar Beet Field — 1941

Bainer: So the committee decided to visit likely places where this work could be done with the idea of either putting all or a part of the money there. They were pretty well familiar with Fort Collins, which wasn't doing much at the time in beet mechanization. They even went to Minnesota, Idaho, Washington State, and finally came to Davis. Professor Walker was the chairman of the department, and I know nothing of the details of arrangements, but I do recall when they all appeared in the lab, one of the things that Walker thought they might be interested in was a demonstration of the internal combustion nut cracker. So we put this thing on and boy, we had a perfect operation that day if we ever had one, and these guys were so intrigued, they felt "If these guys can do something like this at Davis, maybe we ought to just put all our eggs in one basket and drop it here," and they did!

Dickman: Do you suppose this might have been in his mind, to show them --

Bainer; I'm just sure it was. Walker was a very clever man! Pretty clever! But it was all so nonchalant, you know, and it just so happened that we were working on this, you see. This was prearranged, I can assure you. But we showed them some other things that were going on. And first thing we knew, much to the disgruntlement of other institutions, and I can tell you, they were really disgruntled. I'll never forget some of the real bitter criticism that we got from some of the other places, especially Idaho, which was right in the heart of the sugar beet activity, and those poor guys really needed the money, much more than we did. I mean, they didn't have much to work with, and then to think that they dropped the whole lot right here at Davis. Hobart Beresford, Chairman of ag engineering at Idaho, never got over that.

Dickman: Eventually this turned out to be how much money over the years?

Bainer: Over the period of ten years, we got one hundred thirty-two thousand dollars from the U.S. Beet Sugar Association, and the University more than matched it, so there was about a quarter million dollars went into this project which isn't very much money today.

Dickman: More like two and a half million today.

Bainer: Yes, probably would be. [Laughter] Well, there was one more thing that I failed to mention, and that is that E. M. Mervine had been stationed here by the U.S. Department of Agriculture for several years, and Mervine was the only man in the United States that was doing any work on sugar beet mechanization. Walke did a little cooperative work with him, but no other departmental member was really involved until he needed some help and we'd go

Bainer: out in the field and help run tests. So Mervine was here, and that meant that there had been some effort put in by the U.S. Department of Agriculture in a cooperative arrangement with the University of California in sugar beet mechanization. Mervine had worked with a company in Columbus, Ohio, known as the Scott Viner Company. This company built a harvester for red garden beets for canning. A man by the name of William Urschel designed this machine and it was very, very clever. I mean Urschel was a real machine designer. It lifted the beets, by grabbing their tops at the same time a plow loosened them from the ground. The top conveyer was set at an angle about thirty degrees from the ground, so as the machine moved ahead the beets were elevated out of the ground and up through what he called a roller bar assembly which worked all the beets up to a firm position against the crown. Then a pair of rotating topping discs cut the tops off just below the roller bar assembly. This was a real wonderful idea. The only thing that prevented its use was the lack of tops at harvest time in sugar beets. In California when you pull the water to get ready for sugar beet harvest, the tops wilt down and you can't depend upon the tops being strong enough to hold the weight of the beet.

Dickman: What do you mean to pull the water?

Bainer: Stop irrigating.

Dickman: How else does the sugar beet differ from the red beet?

Bainer: The red beet, of course, is very small compared to the sugar beet and it's more like a bulb. The sugar beet is a long tapered root as a rule. But this idea that Urschel had was incorporated into a sugar beet harvester in Ireland by Austin Armer whom I mentioned we'd brought in here to work on sugar beet mechanization. He was called to Ireland to help them out with some problems after he left us and was working with Spreckels Sugar Company. He spent about six months over there. Under Irish conditions, which was typical of English conditions too, they had abundant tops at harvest time. He was asked to design a sugar beet harvester and he designed one using grasping chains for lifting beets by their tops, but he never stayed long enough to see the machine built. The Irish Sugar Co. went ahead and built the machine according to Austin Armer's design, and it worked from the beginning, and it's known as the Armer Harvester, and Austin had never seen it work until this year. Only last fall I got the report of the comparative trials which a British corporation runs every year, and the Armer was right up to the top of the list in performance.

Bainer: It wasn't long after the grant was made that we were in business in a big way. It was necessary, of course, to hire some people, and we hired John Powers to come in and work on sugar beet machinery -- on harvesting -- and we hired Armer to work on harvesting and Vernon Tramotini to work with Powers on separating beets from clods. And we hired Lory, who was a journeyman machinist from Oakland. Another chap by the name of Percy Simmons was hired as a field man. We more or less divided up the responsibility. McBirney, who was with the USDA,was very much interested in planters. I was interested in everything, but I got off onto the seed processing end of the thing as one of my contributions. So the project moved ahead. I think we had a total of eight people working on it part of the time; some in the shop and some developing machines. It was a real interesting and rewarding experience.

Dickman: Were some of these people working on the harvester while you were working on the sugar beet seed?

Bainer: Yes.

Dickman: Was it necessary while you were working on the seed to have success in that before you could harvest?

Bainer: No, no, we were working on all phases simultaneously. We all knew that anything that could be done towards reducing the finger work in thinning would result in labor saving.

I suppose that probably the best way to start would be with the seed, I mean, this came rather early. The U.S. Beet Sugar Association appointed an advisory committee consisting of a representative from each of the companies to meet with us periodically. This committee consisted of general agriculturists, vice presidents and presidents of the various companies. I remember the first time they came, before we'd started anything, just to get acquainted, and to help ferret out anything we might want from their companies, like the photo file of all the harvesters that Great Western had tested years before. Well, this group showed up, and I remember one comment that Professor Walker made after they left; he said, "That's the last time we'll see that bunch of brass." He was wrong. That bunch of brass came here twice a year for almost ten years. They came because they were getting something, you see.

Dickman: When they first came, they gave a list of priorities, you might say, the things that they wanted us to work on. In what priority?

Bainer: Well, there were a lot of things -- well, they wanted a harvester.

Dickman: That was number one?

Bainer: That was number one. Nobody said anything about the seed. They would have liked to have a single germ seed, but nothing was ever said. They wanted a harvester, because that was the back-breaking part of this work. And they figured that they could get along probably with the labor they had during the rest of the year, but they were wrong even on that. They were wrong on many things that they suggested. Many times they just had an erroneous picture that had developed over a period of time. They were too close to the forest, again, and we could stand back and begin to see flaws in many of their suggestions. Herman Zitkowsky was the president of the American Crystal Company in Denver which had had a factory at Clarksburg. Zitkowsky was Russian and had spent quite a little time in Europe. I made a remark one day that there ought to be some way of reducing these seed balls down to where they'd come near to being a one germ unit. You see, a sugar beet seed ball is a flower cluster that goes to seed, and in this flower cluster there could be anywhere from one to five or six little locules around the outer edge, each one having a germ. The practice had always been to plant, oh, twenty pounds of whole seed per acre, which just gave you a ribbon of plants which were just as thick as the hair on a dog down the row, and then they would come in with Mexicans with short handle hoes, and practically working in a stooped over position all day long and sometimes down on their knees, chopping across the rows with a six inch hoe, in one hand, and pulling out all except one plant with the other. The aim was to reduce the stand to one plant every foot. A hundred beets for a hundred feet of row was the old standard. It changed a little bit as mechanization came in. They tolerate a lot more beets in a row now, and it doesn't make too much difference. Really, old Mother Nature can only put so much in the total beets down the row, and whether they are spaced ten inches or fifteen, it really doesn't make a lot of difference. But they thought it did. They thought it had to be a beet for every foot, and that's why they planted so much seed. They wanted to be sure the plants were evenly spaced.

Dickman: How'd they plant the seed?

Bainer: They had drills to plant the seed, and these drills were planters that just dribbled out the seed. They had a tube that extended about thirty inches from that plate to the ground, and that spread it out as it fell down the tube. An opener that formed a furrow for the seed and then closed it was used.

Dickman: Random drilling, then?

Bainer: Yes, random drilling -- that's exactly what it was. So anyway, it took twenty to thirty man hours to thin an acre of sugar beets. I mean this was tedious work. And when they got through, those beets that were left had been so manhandled that they were just laying flat on the ground. I never could understand how they could recover but they did. It just made you sick to go in the field immediately after they'd thinned, because of the closeness with which they were working with these plants and the effect they were having on the plants left. And they didn't always leave the best plant, you see. They left a plant where it was in the right position regardless of size.

I mentioned to Mr. Al Scuderna of the American Crystal Co. on one of his visits that I'd looked up the literature on the breeding of a single germ seed ball. I thought -- this was the way you get to this thing. Get a plant breeder in here and do the job. I went back in the literature, and it starts way back in the 1890s, and found that plant breeders were working on mono germ seed. And as you read the literature it looked more and more promising. About 1912, all the literature stopped. And I could never get an answer to why they quit. I apparently didn't see the final article. Well Scuderna knew why it stopped. It was because the breeders were up a blind alley. They thought they were on the right track but finally decided it wasn't going to be done. Well, I still didn't believe it. I mean I don't know anything about plant breeding, but I just couldn't bring myself to believe that there wasn't some way for a plant breeder to come out with a mono germ seed. Of course, it wasn't for me to say.

Well then, I mentioned to Mr. Zitkowsky at one of these meetings that maybe we could do something to the seed mechanically to reduce the number of germs in the seed ball. And he said, "You know, the Germans have been working on this." Of course we were not in the war then. But it was difficult to get anything out of Germany. He told me a place in Germany to write, and I wrote to the experiment station at Halle and I got an answer. This was during the war. We were not in the war yet.

Dickman: Around 1939, then?

Bainer: No, '41, somewhere in there. And I got a letter from the experiment station, at Halle, Germany. They were very nice. They said they were working on it, but they didn't reveal a thing. It was just a worthless letter. So I went down to the shop and took some of this seed and thought, there must be ways to kill the germ, maybe on one side. So the first thing I tried was to heat the seed on one side. I did this just by using forceps to hold the seed against a hot plate. When it touched that hot plate it killed everything. There wasn't anything dependable about just killing the germs on one side of the seed ball. So I eliminated

Bainer: that method in a short order.

Dickman: Can you describe -- just what does the seed look like, the whole seed?

Bainer: Oh, the whole seed is a very rough cluster. It is a flower that went to seed. It's dried up and it's very, very rough with locules around the exterior. They are covered with a little cover and each locule is a separate cavity.

Dickman: A coarse texture?

Bainer: Well the seed ball itself is. The locules are made of stone cells, just like the cells of a peach pit. And they're hard. And there's a little cover over each locule that is held by some kind of a gelatinous layer that disintegrates when it becomes moist so that the moisture can enter the locules and germinate the seeds. The seeds are not attached to anything in there. They are free seeds and look a little like flax seeds. When they germinate they push the cap away from the locule, and contact with the earth, and grow. There may be four or five locules in a seed ball so you could have that many plants from each seed ball.

Well my next thought was, I'll grind these seed balls down to half size, and when I grind them to half size I'll destroy the seeds in the half thats destroyed. We had a sander belt in the shop. I measured a lot of seed balls, and I decided that I was going to grind them down to eighty thousandths of an inch in thickness. I added a rectangular bar which was spaced 80/1000ths of an inch above the sander belt.

Dickman: Metal bar?

Bainer: Yes, metal bar. I figured, well now, when these seeds grind down to half size they'll slip under the bar. The first problem I ran into, was how could you hold these seeds against the belt and prevent them from rolling. If you're going to grind them down to half size, you had to hold them down with pressure, to reduce them to where they'd slip under the bar. Well, it was discouraging. I mean, how in the world were you going to hold these seed balls. But, I kept fooling around, see, and I fed seeds on to the belt. I looked at the material that passed under the bar and it looked like junk. However, when I screened it, there were flakes of the seed ball. The flakes appeared to have locules containing seed in them. So I screened the material using three of four different screen sizes. We weren't doing any germination here at the time. So I took it to the State Seed Laboratory in Sacramento. There was a gal over there, by the name of Birdie Tower

Bainer: and a very obliging person. (She'd germinated thousands of samples of sugar beet seeds for different sugar companies). I said, "You know, I may have something here. I'm just kind of curious to know what it is. I've been trying to reduce these sugar beet seed balls. I said, "I'm trying to get seed balls down to approximately single germ units, and here's my first attempt. It's more or less accidental. I built a device to do a certain job and it isn't doing it the way I want it, but here's what I have." And she germinated that stuff. And you know, it was just fantastic what came out of it! I mean, we had a lot of duds -- I hadn't done any air separation, you know, to take out the light stuff. It was just a mechanical screening. But I had one layer of that stuff between two screen sizes that came out 1 and 1/10th seedlings per seed ball. She was more excited than I was, really! She said, "You don't know it, but you really have something!" She was the most encouraging person. So I came back and I started in doing more work. And then, of course I developed a cleaning process to upgrade this junk that I had. I had to get rid of the light stuff which had no germs in it. You see, the germs were heavier than the corky material, so it was possible to separate germ containing pieces. I prepared some of this material and we planted it down where Aggie Villa is now, just east of Roadhouse hall. That was all vacant land. It eventually became a victory garden during the war for the campus, but before the victory garden we had it for growing sugar beets. So I planted about an acre of this stuff.

Of course it was all planned to be just at a certain stage when the advisory committee came. You have to be showmen in this sort of thing. McBirney had built a planter that was what he called a single seed ball planter, and he had some small cups on it, which were about right for these segments, you see -- we called it segmented seed. As I recall, we planted about five pounds per acre, which is way under the old twenty pounds per acre we used to plant. I did some thinning with a long handled hoe myself, as I said, at the old experimental station in Amarillo, Texas, I could go out and hoe beets. I demonstrated that I could handle an acre a day -- and still do it with a long handle hoe. On this basis there was a saving of ten man hours per acre.

Dickman: Right there.

Bainer: Right there. And all stand up work, long handle hoe work. Women could do this, you see. Let's see, we figured a saving of ten man hours per acre and we had a million acres of beets, so that was ten million man hours that we could save in the United States. And I think that was the first year of the war. Well, the committee came here, and honest to goodness, I never saw such ex-

Bainer: citement -- they were just almost jumping up and down! So the next thing I knew, everyone of them sent a sack of seed for me to process so they could all have a chance to try the segmented seed in their home territory. They all agreed that they would equip a planter with extra cans so they could go into a farmer's place and make a round with this seed and then move down to the next farmer's place and let him make a round. Everybody was going to have a chance at this. It was one of those things that was a success from the beginning. It was comical. It was unbelieveable. You would never have thought of releasing anything like this from such short work in this University, had not the committee just taken it away from us, you see. And they were footing the bill, and of course, the war was on, and they were all looking for anyway to save labor. And so, this segmented seed went over throughout the whole United States like wild fire.

Bion Tolman,who was agriculturalist for the Utah-Idaho Sugar Company (just retired as one of their vice presidents), became a little concerned about this segmentation process after two or three years of use. He showed some pictures at one of our sugar beet technology meetings he had taken of seedlings from segmented seeds that had been planted in a box with a glass side so you could observe and see what happened. He showed some seedlings that didn't know whether to send the root down or up.

Dickman: Like the old lima bean.

Bainer: Yes. And it disturbed him. Well, in the meantime, we figured that maybe we didn't have quite the factor of safety we needed in this seed. After all, Mother Nature put a big factor of safety in this seed and we were reducing it. So, I immediately started on a second process, which we called decortication, which was simply rubbing the seed between a stone and a rubber pressure pad until it was reduced to a certain size. The very severe rubbing liberated a lot of cells and reduced the amount of seedlings germinated per seed ball -- to about one and a half.

Dickman: Not as good as segmenting.

Bainer: Not as good as segmenting.

Dickman: Now tell me, did you have an idea about this before you learned of this damage?

Bainer: No, no. I didn't have any idea because I hadn't experienced any difficulty. But -- Bion Tolman was a real scientist. And he was a little concerned. They were using it, understand, everybody was using it, but they were all wondering why once in a while something happened, you see.

Dickman: So after you got that word you started working on this new process, called decortication?

Bainer: That's right.

Dickman: How long did it take you to think of this rubbing process?

Bainer: It didn't take very long. I mounted a carbarundum stone on a verticle shaft and I had to play around with different compositions of pressure pads.

Dickman: You used a rubber pressure pad?

Bainer: Yes, neoprene. I also found how essential it was to feed that unit symetrically rather than introducing the seed balls at an angle to the center of the stone. This gave an uneven layer in the machine. This happened and we --

Dickman: You wore out the cylinder pretty fast?

Bainer: No, the rubber pressure pad. Well, anyway, I ran into a lot of difficulty I won't get into here, but the point is we started with this decorticated seed then, and we were planting it every two weeks on the University farm, and there was a farmer by the name of Bernell Harlan near Woodland who had graduated from Davis and had been one of our boosters and one of our cooperators and was always looking in on what was going on. And he was growing sugar beets. For some reason or another Bernell used to come down periodically and he saw these plantings of decorticated seed. And all we had was just what we had planted here at Davis, and as I say, just starting in October we planted every two weeks right through the winter.

Dickman: In the same section?

Bainer: No, no, we were out in the vegetable crop farm then. We lost the other area to the victory garden during the war. And so Bernell came in one day in 1943, and said that he was taking out a crop of spinach from 160 acres. He was getting the ground ready and fertilizing it and was going to put in sugar beets for a second crop that year. This was about a May planting which was getting kind of late for sugar beets, and he said, "I want to plant decorticated seed." I said, "Where are you going to get your seed?" And he said, "Well, you're going to process it for me." I said, "You've come to the wrong guy. You've seen all the decorticated seed that's ever been planted out on the vegetable crops farm, and I'm just not going to stick my neck out and plant 160 acres of that stuff with the limited experience I've had."

Bainer: Oh, he seemed to be so crestfallen. He said, "Now, if I were to tell you that I'm going to take all the responsibility for a failure. I've been watching this stuff. We're not going to have a failure. But if we have a failure and I have to replant, that's my responsibility. I will not hold you responsible, or the University or anybody." Well, one of the things that I've failed to mention was that I became interested in a development of planters, you see, to go with segmented and decorticated seed, and we had at that time an idea being marketed by John Deere actually, and they had sent us the first one of these experimental planters based upon our findings, and I'll get into this later. I had this planter. And Harlan said, "Of course I'll have to borrow your planter." And so, like a fool, I started decorticating the seed for this planting near Woodland. And I lived with that planting job. He wanted to plant four seeds per foot, and that's a pretty low rate. I went up there at first to see what the situation was, and I found that he had enough water to irrigate 80 acres, at one time. He was going to plant on beds that had been pre-fertilized, and had perfect control of the water. It was near perfect, and, of course, that late it was warm.

I had an extra set of cans for the planter, and I went up there and calibrated that planter every tenth round. It was very easy because I could use a set of cans of which I knew the contents. I knew the lengths of row. I wanted to be sure that he was getting four seeds per foot. If we weren't, I thought we'd be just down the drain.

Well, we planted that eighty acres, the first eighty, and he shot the water in and in three or four days, I never saw anything come up so fast. The warm weather and the water helped. I would say in four days it started to show. And it was the most beautiful field of sugar beets I had ever seen. It was just like a dream. I thought that Professor Walker should see it (he didn't know I was doing this, and I'm sure he would have had a fit). I said, "I want to take you out and show you a field of sugar beets." Walker said, "I'm not going to have time. I'm going to Washington and I'm leaving at eleven o'clock in the morning." I said, "I don't care if you're going to Washington, you're going out to see the field of sugar beets,-- you've never seen anything like it. If you wait to come back from Washington it'll be too late because these beets will be grown." And he saw I was rather determined and he said, "How long will it take?" And I said, "Well, I can take you up there and back in an hour. You ought to allow an hour." Well, he gave me time and I took him up there. Well, he was more excited than I was. And the word got out and we had representatives from all the various sugar companies

Bainer: showing up to see this field. It was a field demonstration which I didn't intend, you see. I don't know why I got involved, but this was what you gambled on, you see. The war was on, we were grasping at straws, etc.

Dickman: I can understand that the decorticated seed would not have the damage that the segmented seed might have had. But why did this stand of beets excite you so much?

Bainer: Well, because it was uniform. You had a little more factor of safety. You see, you don't always get two seedlings for every seed ball that has two germs. But this was a case of just a little more factor of safety. Now, you talk about damage. We did get damage when I first started decorticating. I got this same exact damage that we got from segmented seed.

Dickman: Well if you had the same damage, what would be the advantage of the decorticated seed then?

Bainer: They're more uniform to plant. This was one of the things I failed to mention. That is, this decorticated seed was much smoother than the old original seed, and we graded it down to two sixty-fours in size. In other words, the old original seed was graded, let's say, through an 18/64th screen and over an 8/64th screen, so there was 10/64ths difference in the size. After decortication it was graded through a 9/64th and over 7/64th screen and so we were down to 2/64th range in size and that gave us uniform plantings.

Dickman: Now you're going to come to the precision drilling, but was it the decorticated seed you had in mind when you started developing your precision planting?

Bainer: Yes.

Dickman: I see. So it was a lot easier to plant, and that was a real big gain.

Bainer: That was part of the gain. But I do want to mention that we got this same deformity from our first decorticater because seed was coming off the stone and hitting the steel case causing impact damage, just like beans. We had to put in a soft rubber inner liner to absorb the energy of the seed coming from the stone. And that didn't take very long.

Dickman: And that did it?

Bainer: And that did it. These were problems that really an engineer needed a botanist to work with him. But pretty soon you began

Bainer: recognizing these things yourself because nobody's helping you.

Dickman: What did the plant breeders say about all of this? Did they get a kick out of it?

Bainer: Yes. We didn't have anybody in botany working with us unfortunately on this project. The only man that worked with us was Lysle Leach who had had a lot of genetics background. He was a plant pathologist at this time, but the point is that Leach is a real well-rounded individual, and he did more than just plant pathology -- he really got interested in this whole thing, and he practically joined the ranks and worked with us on certain phases of it.

But anyway, as I mentioned, people came there from all the western states. And the next year we were beginning to get a demand for decorticated seed. It was only a matter of a year or two that we had everything converted from segmented seed to decorticated seed except the Great Western Sugar Company.

Dickman: I was going to ask, did you have any trouble selling the idea to industry?

Bainer: Yes, we did. Not most of it, but the one big outfit, that's Great Western, they said that they had perfected segmentation and it took a long time to get this thing established and everybody was happy and they would not change. They eventually had to, but they weren't one of the first.

Dickman: They were your biggest contributor.

Bainer: That's right but it didn't bother me. But the company that really moved on this thing was Holly. Their headquarters was in Colorado Springs but they had a big operation here in the delta. They had a man by the name of Charlie Lavis who promoted decorticated seed. The thing was that it was something like the segmented deal. When the advisory committee came the next time they had to begin to plan, what are we going to do about decorticated seed? Well, they wanted plans or wanted a source where they could buy decorticators. Ernie Blackwelder had made the seed segmenters available. He manufactured them and even sold some of them in Europe. He then was willing to make the seed decorticaters. We designed a unit that was twice as large as the unit we had here for commercial production.

Dickman: Was burr reduction part of the decorticating process?

Bainer: No, that's still another process which we just gave up on. That was just to get great big seeds broken preliminary to de-

Bainer: cortication. The thing is that that burr reduction was a good idea, I think, but it was an extra operation that you couldn't justify.

Dickman: And you didn't need it?

Bainer: No, didn't need it. There was this committee that I mentioned that came out here for consultation with us every six months. We gave them plans or a source where they could buy a decorticator. We had made arrangements with Blackwelder Manufacturing Company at Rio Vista to build them on order. It was agreed that no company would plant more than five hundred acres of the seed the first year. We figured we'd better have a soft approach here. It was in the Spring of the next year after the experience at Woodland. I was at Berkeley and the telephone rang and it was Charlie Lavis of the Holly Sugar Company at Stockton, and he said, "When are you coming down to see this decorticated seed planting?" I said, "Well, this is the first time I've known its ready to be seen. How many acres have you got?" He said, "I don't know but I'll figure it up and call you back." I said, "I'm going back to Davis, you'd better call me in the morning." So he called me at Davis the next morning and said "We've got about five thousand acres of it." [Laughter] And I said, "You're a bigger fool than I thought you were." He said, "I don't know, you'd better come down here and take that fool back." So I went down, and it was just like it was at Woodland. I never saw anything as beautiful as those sugar beet plantings. They were just all excited and this guy Lavis had taken the bull by the horns and had gone all out. He was having trouble with the machine, and that's where I found out about the actual uniformity at which this machine had to be fed. The feed had to be symmetrical, otherwise you just wore off one side of the pressure pad because you overloaded the quadrant opposite the angle of feed.

Well then, of course, we were already working on the planter. So now, there's another rather interesting experience. I think I mentioned that we set up a laboratory method for mounting a planter and driving it equivalent to the ground speed in the field, say two and a half or three miles an hour. Then we wanted to see what the distribution of seeds was from the planter so we rigged up an endless belt onto which we could feed boards that were eight feet long (they were one by six inches by eight feet long) and we coated these boards with grease like axle grease or cup grease. We could feed these boards onto the belt and pass them under the planter unit at speeds used in the field. The seeds were caught on the grease-coated board. We had a frame that went over the board on which we had cross wires of one inch intervals. So then we could work out a statistical

Bainer: analysis of where these seeds were, and we figured we didn't need to go down below an inch, you see. Dr. Fred Brooks in ag engineering and Dr. George Baker in mathematics developed a statistical method for analyzing the distribution of these seeds on the board. I mean, everybody got into the act. Well this was a very useful method for determining whether these planters were uniform in distribution. We had occasion to try many different types of planters.

Dickman: On your retirement they gave you a grease board.

Bainer: Yes, they gave me a section of a grease board in a plastic case. I don't think Emil Mrak ever understood what I tried to tell him was involved in that board.

Well anyway, one of the things that dawned on me while I was watching these grease boards was that we had an opportunity of putting different conduits between the planter unit and the greased board. We had used the spiral ribbon tube which was standard. So, one day I said, "You know, I'm going to put a glass tube in there." We had a stroboscopic light and I said, "I'm hoping that we can operate this strobe light to pick up the bounce of those seeds in the glass tube." And I knew that they came out of the plate with a horizontal component of velocity as well as vertical, and they would hit the tube and then zig zag through. I never got the light timed right, even though I tried. It was very evident that I'd gone far enough, because this glass tube, about a half inch in diameter, was receiving these seeds, and they were coming out the lower end of this tube in the same relationship with the introduction at the upper end. In other words, here was a smooth tube in this flow, and it was the most revealing thing, and of course you just saw the picture immediately.

Dickman: Now this is the second accidental lucky break?

Bainer: Yes, accidental. Trying to do something else and --

Dickman: First the steel bar in the segmenter and now this.

Bainer: And this. But much research, of course, is observation, and also, the fact that we had a very workable method for evaluating these planters. You could see it in an instant. When you put this glass tube in there it was just unbelieveable the uniformity of seed spacing. Well then, of course, the next thing was --

Dickman: Why was that?

Bainer: Because we had been using a spiral ribbon tube, and that had an advantage where you're dropping out globs of seeds at a time. It helped distribute them. But when you took individual seeds, you could introduce two seeds in succession at the upper end of that tube and they might come out in reverse order at the lower end. We were having skips and we were having two or three seeds in intervening inches. There was just no uniformity at all, and that's what they were using, the old spiral ribbon tube.

Dickman: It wasn't so much the glass; it was the fact there was no spiral ribbon?

Bainer: That's right. The fact that we didn't have the old spiral ribbon tube. The glass was smooth. And so, here was a problem of these planter units being thirty inches above the ground level. So the next move was to replace the glass tube with chrome-molly tubing. It worked just as well as glass. So we got two sizes of chrome-molly tubing rigged up on these planters that were thirty inches above the ground, one telescoping the other, so that when you lifted the openers, the tube between the opener and the metering device which was thirty inches above would telescope just like a trombone. So you see you could lift the openers and let them down, and each time you lifted and let down, the telescoping part either extended or contracted. Well, this was still ridiculous, but we had lots of planters in the field, and this was a means of conversion, you see.

Then we got hold of John Deere and said, "Now, there's no reason to put that can thirty inches above the ground, why don't you mount the can down on the opener, and then you'll have a very short distance to drop the seed (fourteen inches, I think). Then you can put in a stainless steel drop tube." This was the planter, then, that we finally got into the field up at Bernell Harlan's. It was one of the first John Deere's that had this smooth tube.

I think probably there are several things we ought to talk about. One is the seed. I don't know that I mentioned that the seed processing, which first was just a segmentation and then was followed by decortication, was a stop-gap program really, because we were waiting for the plant breeders to come up with mono germ seed. And I think I mentioned that there had been several efforts made and they all terminated by 1912, and it wasn't until many years later that a Russian couple, a man and his wife, Mr. and Mrs. Savisky, were doing similar work in Russia. They didn't want to live in Russia, and I don't know how they got out of the country, but they emigrated to the United States.

Dickman: Back in the '40s?

Bainer: Yes, late in the '40s, and the USDA picked them up and stationed them out in Utah where there was some seed produced. And they came up with mono germ seed. And I'm told that, like Madame Curie, the wife Helen was the one who really succeeded in getting mono germ seed.

I gave a paper at the ASAE meeting in Portland in 1948 on the subject of seed processing and planting. (The Processing of Sugar Beet Seed Agricultural Engineering, 29(11):477-479, Nov 1948.) Fortunately in this paper I mentioned the fact that the mechanical processing of seed, I felt, was a stop gap program until the plant breeders could come along with mono germ seed. This is exactly what happened. But we did fill a need for about 18 years before we had the mono germ seed.

Once the seed was singled, or mono germ seed used, we had precision planters or improved planters for placing this seed in a more uniform manner.

Then came several efforts toward mechanical thinning or mechanical blocking of sugar beets. Professor Mervine (he was a professor at Iowa State before he went to USDA) worked on the mechanical "blocking" in which he cross-cultivated taking out predetermined spaces according to the stand counts. In other words you went in and made a stand count and then there was a statistical analysis made and he finally came up with a method for blocking out seven inches and leaving five, or blocking out eight and leaving two, depending upon the stand. This was never too popular because many times you'd leave the two inches and there wouldn't be a beet there and you'd take out beets that were adjacent to it.

Then he changed his whole theory and decided just to thin out the stand by say, cutting out an inch and leaving an inch. Just about like a cross harrowing, you might say. And there were modifications of this idea in which they simply used pencil weeders which were little steel prongs that entered the top surface of the soil when the beets were small, which would pull out these small beets but leave an established plant. There were many efforts to use this pencil weeder just as a cross-cultivating tool to reduce a stand. They were attempting a random reduction and maybe you'd cross cultivate more than once.

Then there were several down the row thinners that came out, left a block and cut out a block. They were used to some extent and

Bainer: could hold a planting of beets say, for a while, awaiting the final thinning either combined with the first hoeing for weeds or as a separate operation.

There were also several attempts to build electronic operated thinners. Leo Marihart, a farmer near Salinas was a pioneer in this area, and he came up with a -- oh a very sophisticated machine. It took four rows at a time. And he made use of an electric eye. This electric eye was directed across the beet row; the idea being that cutting of the light between the target and the electric eye would actuate a mechanism which would cut out a pre-determined amount of the row. But it would leave that first plant. You see, what everybody wanted to do was to be sure that there was a plant left on the block that was undisturbed. And Marihart's machine would do this, and there were four or five of them built and sold. One of them was sold to Lester Holmes in the Clarksburg area. This machine had a lot of merit, but was very complicated. Hewlett-Packard at Palo Alto manufactured four or five and finally gave it up. It was just too complicated as a farm machine. Marihart's theory was that you did not only use this machine for thinning, but you used it for hoeing, too. After you once got your stand established, then you could go down your row and cut out the space that was between the beets that you had left, because this unit always left the first beet it came on and say, took out seven inches or so of the row and it wouldn't be actuated until it came to another beet. There were other methods that were tried. The most successful one was one that Roger Garrett of agricultural engineering developed. He called it a synchronous thinner. He simply used a little feeler going along the row, and of course this feeler couldn't tell the difference between the weed and the beet and neither could Marihart's machine. Marihart thought he'd be able to get a gradation of color response from this electric eye that would differentiate between the weed and the beet, but he never accomplished that. This synchronous thinner was a down the row machine, and it, again, would actually contact the beet with the little feeler, which actuated a mechanism to operate a knife that would whip across the row and take out a predetermined amount of the row.

Dickman: But leave the first beet?

Bainer: It left the first beet. This machine is now commercially available. John Deere picked up the license to build this machine commercially, and since it's been in the field, there must at least three or four other imitators now that use about the same principle.

Bainer: It is possible now with mono germ seed, precision planting, and the synchronous thinner to practically eliminate the need for hand thinning. This is a very important victory, in a way, because the thinning period is rather short, but you can thin without damage to the crop, because when the plants get larger you're working under difficulty to take out the ones that you want to take out and leave the ones somewhat undisturbed.

Professor Walker made a study of the actual labor requirements in sugar beet production and showed a much higher peak labor demand in the spring for thinning and hoeing for weeds than in the fall, during the harvest. There are other factors that kind of take away some of this difference however. In the fall the sugar beet harvest spreads out over maybe three or four months, and now is carried even into the spring, in case of winter rains.

The problems with sugar beets was competing for labor with a lot of other crops that have to be harvested -- rice and fruit. While the work in sugar beets in the fall didn't have to be done in the exact period like it did in the spring when they were thinning, the competition from other crops made it difficult to always get the labor to harvest the beets. And furthermore, hand harvesting was very hard work, and you had to get people from certain ethnic groups to do the work.

Dickman: Now, what would you estimate were the labor savings, particularly during the war years, as a result of the developments?

Bainer: There was, sure, considerable saving of labor. In 1947, Professor Walker indicated that the saving in labor amounted to two-thirds. At the present time, I would estimate a labor saving of 75 to 80 percent. But the situation was -- the important thing, I think, of the mechanization during the war years, while it was labor saving--it kept the industry alive. I was told, for example, by people in companies that operated in the inter mountain states like Utah and Idaho, that the use of segmented seed prolonged the period that was available for thinning. In some of the remote areas, they were as much as two, three, or four weeks behind in thinning because they couldn't get labor. The light stands from the segmented seed gave them a longer period before they had to be thinned. And so I think of this as more or less of an incentive to keep growing sugar beets.

Dickman: Do you recall anything at all -- I know we're talking about ag economics here -- about the acreage before you developed this seed treatment and thinning and so on, and after you developed it?

Bainer: Well, it's been up and down, actually. There has been curtailment of acreage because of surpluses. Again, we had about a million acres when we were doing this work. In 1972 there were 1 1/3 million acres in beets in the U.S.

Dickman: And during the war?

Bainer: I think practically it held its own. But we felt it held its own because there was this incentive and it was encouragement. People were willing to gamble a little that new methods would be available to help handle crops. No, I don't think there was a big increase in acreage like there was in rice, for example.

Dickman: Just for a matter of information, chemically there's no difference between the sugar beet sugar and the cane sugar?

Bainer: That's right. The chemist can not tell the difference.

Dickman: Can the consumer tell any difference?

Bainer: Well, at one time I'm told that they could. That the beet sugar was a little coarser and contained more impurities than cane sugar. Chemically they are $C_{12}H_{22}O_{11}$. And now the refining process in sugar beets has been developed to the point where they put out a comparable product.

Dickman: Now what was the Dixie thinner?

Bainer: That was a down the row revolving thinner that had blades that rotated. It was adjustable to give varying lengths of the cut out section.

Dickman: Now, you wrote a paper on that. Does that mean that that was your baby? [Sheared Seed, Dixie Beet Thinner. New Agriculture, May 1943]

Bainer: No, we were of course following every type of thinner, and that was one of the first down the row thinners that came out. A man down in the South built this Dixie thinner, and he barnstormed the country with it. Had one at Davis on a couple of occasions, and it was all right. I mean it was in the same class with cross cultivation. It just broke your heart to see a poor stand and then the thinner would come along and thin out the best beets. [Laughter] This was what all of them did. You ended up pretty well. I mean, actually, the end product was better than it looked like, when you were doing the thinning. And the sugar beet has a great ability to reach out and get energy from whatever area is available to it. So that thinning

Bainer: of course was important, and thinning with the minimum amount of disturbance, of what was left, was very important.

Dickman: Now, while all this was going on, this team was working on the harvester?

Bainer: Yes. We had two men that were devoting full time to harvesters. One was John Powers who was making a very scientific approach, let me say, and Austin Armer who was making a more practical approach. Both came into the picture without any background in agriculture whatever. And I remember one day Powers came into the office that McBirney and I were occupying. Powers said, "I wonder if there is any thing regarding the relation of thickness of the crown to the size of the beet?" We knew there was some relationship because the sugar beet companies, nation-wide, at that particular time, had instructed growers that all beets up to three inches in diameter would be topped at the lowest leaf scar. Larger beets were to be cut 3/4 inch above this scar. A heavy concentration of impurities of the beet is in the crown. Powers was interested because this was going to complicate mechanical topping if you had to top these beets with the precision they had been used to. And he wondered if there was any relationship you see, between the beet diameter and the thickness of crown, and I remember McBirney saying (and he was guessing, he didn't know, and neither did I, certainly), but he said, "I wish there was, but I doubt that there is." It was just an indefinite answer. Well, that didn't satisfy Powers. Powers went out to the field and started measuring everything he could about sugar beets, as they grew in the field. And the first thing he had to do was establish the original ground level. You see, as you grow sugar beets you cultivate between the beet rows, and during cultivation, you throw soil up against the sugar beet. So it appears that the sugar beet is growing on an elevated ridge, and then there's a depression between rows that carries the irrigation water. This, of course, was when the beets are originally planted on a flat surface.

Well, what Powers did was to rig up a little frame on runners. The farthest runner from the beet row ran in the furrow, and the other runner ran right along the side of the beet. And then he figured that half way between the two runners was the mean, or the average of -- the level of the ground, so that his reference point then was half way between those two runners in this framework. Then he started measuring the height that the beet grew above that average ground level. He also measured the diameter of the beet, and the thickness of the crown, to the best of his ability. He came in and tabulated and plotted all this information, and lo and behold, there was a three-way re-

Bainer: lationship. There was a relationship between the diameter of the beet and the height that the beet grew above average ground level. The bigger the beet the higher it grew. And there was also a relationship between the thickness of the crown and the diameter of the beet. So he established a relationship between the thickness of the crown and the height the beet grew above the ground.

He came up with a variable ratio between the finder and the knife position. You see, as the finder went down the row on the top of the beets, the finder was supposed to set the position of the knife entering the beet, so that the higher the finder raised, the greater became the distance between the finder and the knife. So on the big beets you took off a bigger slice than you did on the smaller ones. And this averaged out. He plotted this curve and while it wasn't perfect, but if you went through the whole range of sizes, it averaged out just about as good as hand topping. And they use this variable ratio in toppers today. This information was published: The Development of a New Sugar Beet Harvester. Ag. Eng. 29:347-351 August 1948.

I also remember he built a little topping unit on this sled that I talked about, that you pulled down the row by hand. He had a narrow driven finder that would thread its way through the beet tops. It has a lugged chain, that would climb over the beet. And then he had a narrow blade knife that was positioned by the finder and topped the beet. And, of course, it was so fixed that once the knife entered the beet, even though the finder was going down the back side, the knife gauged its way on through.

Then he began noticing that there was a break on the backside of the beet. Actually it was on a forty-five degree angle down the back side of the beet. Well, this was a loss of beet. And so he made a laboratory set-up where he could oscillate the knife, similar to slicing bread. This reduced the cutting force. You were putting an angle on the cutting force. In his bench model he could vibrate the knife at different frequencies. He had an arrangement for pulling the beet through the knife as it vibrated and measure the forces required. He found out that to pull this knife through a three inch beet took a 60 pound force. But when he started vibrating the knife, he began to reduce the force required to pull the knife through the beet and also reduce the tendency for breakage. When he got up to sixty cycles a second with this vibration, he reduced the force required to pull a knife through the beet to fifteen pounds, one-fourth of what it was before, and at the same time, reduce the tendency to break the beet. This gave him a real sophisticated topping mechanism. He and I tried this machine in Idaho, Utah, and

Bainer: California during the fall of 1939. First just as a topping element, that's all he had to start with.

Dickman: With the idea that you'd top them in the ground and then harvest them?

Bainer: Yes, that was one approach you see, and that seemed to be a logical approach if you were going to gauge these beets and do an accurate job of topping comparable with hand topping. Well, I remember I went with John Powers and we made a barn storming trip down through Utah and Idaho that first year. He had a little engine on there with a flexible drive to the finder to vibrate the knife. And he built a very ingenious vibrating device which was an eccentric; he weighted a pair of gears that would build up the force perpendicular to the beet row but dampen out horizontal with the beet row. He didn't want to shake the mechanism apart, and all he wanted was a vibration crossways. This inertia type of drive that he built on this beet harvester came into use in an entirely different field later on in connection with the inertia tree shaker.

Well anyway, I remember we were at Garland, Utah with this device, and Powers and I were out in the field. In fact the factory manager, Mr. Christianson, had been out two or three times to see it. Finally, after we had pulled this sled down the row and had topped a row of sugar beets, we laid the tops next to the beets. Again we asked the manager to see the results. The job of topping was really superb. But you know, that manager was most critical. It showed the attitude, you see -- that factory people did not want to have anything to do with mechanical harvesting. They knew that there was going to be trouble with trash and leaves and so forth, and so there was this resistance that you had all the time. I'll never forget when we got in the car to go back to the motel that night, Powers said to me, "I'll tell you one thing, Roy, if we get an absolutely perfect job of topping those beets, he'll never accept them." Powers was really worried that nobody would ever accept it. And well, of course, there was another factor that came into the picture and that was the war, and the loss of sugar beet acreage. The factory managers might not hold their jobs. To keep the factories running they were going to have to accept some things that weren't ideal. I can remember the factory superintendent at Clarksburg, when some of these early mechanically harvested beets came in. They looked like loads of hay, they had so much green stuff on them. But he said, "Roy, we've got to begin to learn how to handle this stuff, because if we don't, this factory's going to shut down." He had the right idea. And we had a few of these people that saw the handwriting on the wall, and my only remark was "Well,

Bainer: we'll never do any worse than we did this year." We had some chance for improvement.

Dickman: Do they use the tops for anything, like feed?

Bainer: Not so much. Well, they do in certain areas. In the inter-mountain area, tops are conserved for cattle feed -- excellent for cattle feed. But right now in California, I'll tell you, all the effort that we put in twenty-five years ago, it would seem, is down the drain when you go out and watch them top beets now because they're just scalping them. You see, this is where you get some bum steers all the way along -- they said it's got to be as good as hand topping. And when you go out and watch them top sugar beets today with machines, they're just beating the tops off of them with a rotary beater, and may or may be scalping them a little bit, and away they go to the factory. So this topping got to be almost a joke. The place where they do have to cut the crowns is in most other areas in the United States; because the beets are piled prior to processing. I've just talked about California. We get by in California because we process the beets as they are harvested. We don't pile them or store them. But, in the inter-mountain area, they only have about three weeks to take the beets or they might be frozen in the ground and then they'd be lost. So they store the harvested sugar beets in huge piles. They have to do a better job of topping them getting rid of some of the crown and leaves. Otherwise, air circulation through these piles is restricted, and boy, they can rot -- go down in a hurry if you don't have air circulation. So we still need the topping that we set out originally in most of the U.S., but not in California.

I mentioned this variable cut topper. The only part of that whole development that ever got into play was the variable ratio, and that is still used. John Deere and Olson use it -- where they actually top them, they use that variable ratio.

Well, there were two other approaches. I mentioned the Urschel machine (the Scott Viner machine) what Mervine was working with, when this delegation came through Davis, to decide whether or not to finance the work at Davis. This would have been a world beater if the tops had been strong enough to lift beets. The serious problem in California was separating beets from clods. When you topped them in the ground, you had a problem of separating beets from clods.

Then there was a third approach, and this was the spiked wheel that was developed on Ryer Island. A farmer by the name of

Bainer: Al Jonganeel went to his blacksmith shop run by a man by the name of Lloyd Schmidt. Jonganeel had the idea of a wheel with radial spikes. You'd roll the wheel right over the beet and the spikes would enter the crown, and you simultaneously plowed the beet loose and the beets impaled on the spikes came over the top of the wheel and were topped off by the wheel. It was a very interesting thing about this development.

Well, one of the things that we discussed and an approach that we felt should be made (and this was before Schmidt ever made the wheel) was the use of a spike wheel. Armer was playing with this idea. He developed a number of different shapes of spikes, curved, and straight, with roughnesses of different kinds on them, and he eventually mounted them on a small wheel. I think the wheel wasn't over two feet in diameter. And he demonstrated, to everybody's satisfaction, that he had a problem of getting the beet out of the ground because of the necessary rocking action. You see it had to rock in the ground to stay radial to the wheel. Well, the problem was that his wheel was too small and none of us were smart enough to see this. And so when Schmidt started it at Jongeneel's request (we had just kind of dropped the idea), he used a four foot wheel and that wasn't large enough. He finally went to a six foot wheel.

Dickman: Had he seen Armer's?

Bainer: No, he hadn't. Not to our knowledge. But the war came along and I'm telling you, things were getting pretty desperate. California had a hundred and seventy thousand acres of sugar beets in 1941, and in 1942 there were only seventy thousand acres. We lost a hundred thousand acres in one year. One more year like that and they wouldn't open a sugar factory. So, things were getting desperate. And while the segmented seed and improved planting was coming along, the harvester development was lagging. It appeared that this wheel had some possibilities. I mean it certainly would get the beets out of the ground. There was breakage of tap roots that was left in the ground. You still had to rock the beet a little bit to get it out of the ground. You still had a very severe lifting problem of trying to hold that beet up against the wheel while you were taking it up out of the ground. Jongeneel and his group took the idea of the wheel to Blackwelder, who built one with a six foot wheel. And fortunately he started the unit in peat soil. Peat soils are very loose, and you can rock the beet quite a bit in the peat soil without breaking it and you don't have the resistance of the heavier soils.

Dickman: Just a quick question. These beets were topped after they came out of the ground?

Bainer: That's right. In other words this wheel ran over the tops and pushed them down. The spikes were three and three quarters inches long and slightly curved. They were spaced 2" apart in rows around the wheel rim. They entered the crown and impaled the beet, you see, and the beet then came up radial to the wheel. There were some inclined lifter bars between the rows of spikes that lifted the beet a little bit so that you could get a pair of rotating discs into the beet just above the spikes in order to top it. The beet was topped as it came over the wheel.

Dickman: And how did this compare in efficiency and quality with the topping in the ground?

Bainer: Oh no, it didn't even compare, but you had the beet out of the ground. And so that topped beet fell over into a conveyor, and then they had another set of lifter points, we called them, running between the rows of spikes that then would lift the crown off and clean off the dirt before the spikes went back in the ground. The war was on. The pressure was great and they had had this one machine working down on the Ringe tract in the delta. I went down and observed it in operation. And they were going along about three or four miles an hour. They were fast. It was a speed demon. You'd just roll the wheel over the row and bring the beets up and boy, they were coming up.

Dickman: And this was a six foot wheel?

Bainer: Yes, Blackwelder's was by then.

Dickman: And you're in the peat soil?

Bainer: Yes, in the peat soil. Well then came the problem -- a new company made up of Jongeneels group, Geo. Gordon and Blackwelder wanted to build thirty-five of these machines. We were still working on a lot of other ideas, and International was building Armer's machine, and Allis-Chalmers had come in and decided they would take Powers' idea and develop it. They spent about a year and gave it up. The new company was faced with the problem of securing materials for constructing thirty-five machines. I didn't realize at that time that Professor Walker was on the war materials board locally, for agricultural equipment, and anybody that wanted steel to build machinery had to get an OK from Professor Walker. Professor Walker had never told any of us that he was doing this. Sometimes you didn't know what Professor Walker was doing; -- well, I suppose he figured this wasn't really any of our business, and it wasn't. But you'd thought some time or another he'd spill a little information [laughter]. Anyway, these four guys came to Walker's office in Walker Hall (it wasn't Walker Hall then, but in the ag engin-

Bainer: eering building) and applied for enough steel to build thirty-five sugar beet harvesters. And Walker turned them down. He said, "You just don't have enough evidence that these machines will work and we're short of material. The war's on." You see, he was very patriotic and was doing his duty. His judgment was certainly sound. He'd never seen the second machine. He'd seen only the first one. What kind of threw him was that when I took him down to Ryer Island to show him the Schmidt machine, it was really pretty crude. (We've got pictures of it.) But it showed some promise.

Dickman: That didn't impress Walker?

Bainer: No, no, it didn't impress him too much. He said, "Don't stop the work you're doing." Well, these fellows told Professor Walker that I had seen that machine and was quite impressed with it. And I'd mentioned this to Walker; he knew I had seen the machine. Well, apparently they said, "If we can get some statements from people who've observed this machine would you reconsider?" And Walker said, "Yes." So these guys came right out of Walker's office into my office and said, "We'd like to have a letter from you stating that you observed this machine working satisfactorily down on the Ringe tract." I said, "What do you need it for?" They said, "We're trying to get some material to build thirty-five machines." They still didn't tell me that the guy that released the material was H. B. Walker. So [laughter] I wrote them a letter, and I was really cagey in that letter, I said, "Under the conditions -- the ground conditions of loose peat soil -- this machine shows great promise in being able to recover sugar beets." And I mentioned the fact that the topping wasn't the best, but they were getting the beets out of the ground and most of the tops were off, and that I had timed the operation and I think in something like three and a half or four miles an hour. Just as soon as I wrote that letter, they took it into Walker's office and left it on his desk. And here were two people in the same building -- one was promoting and the other guy was demoting. [Laughter]

Well, it wound up, that Walker, on the strength of my letter, gave them the steel to build thirty-five machines. And as soon as they left his office he came down to my office and said, "You put me in an embarrassing position. You came out with a letter indicating that this Blackwelder unit had merit certainly under the conditions that you saw it, and I gave them steel for the thirty-five machines on the basis of your letter. It had better work!" I said, "I guess one hand doesn't know what the other's doing around here. I had no idea that you were involved in this thing. It's probably just as well that I didn't because

Bainer: I'd have probably sided with you." They built those 35 machines and they worked pretty well.

Dickman: Did they work in non-peat soil?

Bainer: Well, they put them in non-peat soil before the season was over. They broke more beets off in the non-peat soil. I think to cap this whole climax on the Blackwelder machine; you see, the war was on, and they were really pushing, and they were having difficulty getting engines, and George Grodon knew John McCaffrey, president of the International Harvester Company,and he needed thirty-five engines, twenty horse power size, and he couldn't get to McCaffrey in his office -- with the telephone he just couldn't get beyond a bunch of secretaries giving protection. They were having problems too. But George Gordon thought he knew McCaffrey well enough to call him at his home one Sunday afternoon. And he called McCaffrey at his home and got a release on thirty-five engines for those harvesters. This was a gamble, too, you see. Well, they finally started building these in two row units. Once they got started they really were going.

I'll never forget going down to the Clarksburg area with a group of sugar company people from the middle west, three or four people, who were here to see some of this early harvest. You see, we started harvesting sugar beets in California way ahead of the rest of the nation. In August we were harvesting sugar beets in this area, and in the Imperial Valley, of course, in June.

Well, these fellows from Utah-Idaho, Great Western and Holly companies that were located over in the inter mountain area had heard, you see, about the progress being made over here, so they got on a plane and flew in here and wanted me to show them one of these machines. It was just twelve o'clock noon when we got in the field -- just early enough to see them come down the last row and quit for lunch and actually drag the machine into the shop. And this particular day was the first day that this outfit had ever taken out a hundred tons of sugar beets in a half day, a hundred tons! And I'll tell you, that's a lot of sugar beets! One man on the machine, one man on the tractor, and one man in the truck receiving them. They had pulled this machine over to the yard and had to make some minor repairs, and they were determined they were going to get another hundred tons out in the afternoon, so this would be the first day in history that one of these machines took out two hundred tons of sugar beets. And these guys from Colorado and Utah, I'm telling you, they just stood around with their mouths open.

Bainer: And I said, "Look at the quality. The quality of topping isn't what you fellows would demand." I don't know, but they overlooked a lot. The fact was, there was two hundred tons of sugar beets out of that field.

I went over and visited with the young fellow working in the shop. And this farm had a pretty good shop. I knew this fellow, had known him for some time. He said, "I'm so tired I don't know whether I'm coming or going." I said, "What's the matter, don't you go to bed at nights?" kidding him along. "No, sir, I'll tell you. We bring that machine in and it takes us half the night to get it in shape and repaired to run one more day." You see, the attitude of the farmers in keeping the machines going were correcting some of the faults that were manufactured in that machine. In other words, Blackwelder knew the value of what he got from the farmers to keep the machine going, because at the end of the season it wasn't the machine that Blackwelder sold them. I mean they all found weaknesses and they corrected them in one way or other. And I always thought that was a pretty good statement:"It takes us half the night to get this machine in shape to run one more day." Well, when you're taking a hundred to two hundred tons of sugar beets, you can afford to work half the night. But that's about what those early machines did. But this then became the unit that took over the harvesting of sugar beets in California. We had very little to do with it other than that John Powers worked with Ernie Blackwelder on some plow development to try to reduce the amount of draft. It took a lot of power to pull it. It was a farmers idea of spiking these beets, and the little blacksmith shop on Ryer Island built the first one, and then Blackwelder got into the act.

Dickman: This was the first you'd met Blackwelder?

Bainer: That was the beginning of the relationship with Blackwelder, and a great, fine relationship continued. And he built other things that were developed here, that we'll mention.

Dickman: How many were built the next year?

Bainer: Oh, I don't know. There were probably two or three hundred. I know that he really got in the business in a big way, and he had the whole town of Rio Vista working for him. He just didn't have the labor to do this, and he had people moonlighting down there, during a short shift in the evening. The bankers and lawyers and school teachers, and everybody turned out to help Blackwelder get these machines out. They were building them around the clock.

Dickman: What year was this?

Bainer: It was right in the war period, 1943. The people of Rio Vista were magnificent in coming to his rescue.

Dickman: He must have had a friendly banker to get the capital.

Bainer: No, they didn't have that much money in Rio Vista. He had to get his capital out of Sacramento. He was a man who could go to Sacramento and borrow a million dollars and pay it back within a year, because everything he built and sold for cash on the barrel head, and he had a deposit on the machine to start with and when it was delivered he got the rest. He didn't carry anybody financially, and I happen to know that there were times when he had as much as three million dollars borrowed from the bank.

Dickman: Are they using this type of machine today?

Bainer: Oh yes, but not to the extent that they were before. I think that the Holly Sugar Company has been the only one that's been a stickler for better topping in California. Spreckels is accepting the other type of beet, I mean, that's just scalped.

Armer, I mentioned, who came up with a very plain topping mechanism that just used a little sled finder that wasn't driven, and a rotating disc with the variable ratio between the sled finder and the rotating disc. And there had been several of these attempted before. It wasn't original with Armer. The variable ratio was original with Powers. But the rotating disc had been tried and tried.

But he came up with a very simple topping unit compared with Power's topping unit, and International Harvester started building them. And now that idea, of course, has been built by John Deere and several others. There are many of them using the disc. The disc, you see, puts an angle in the cutting, that Powers put in, by vibrating the knife -- it's the same idea, you get this slicing action and you don't get the breakage on the back of the beet. And so the disc was another way, but the trouble with the finder and the disc was, that you had to have a greater distance between beets to make it work properly.

Another harvester developed by a farmer was manufactured by John Deere. A fellow by the name of Claude Waltz east of Pueblo, Colorado built a sugar beet harvester. McBirney, Mervine and I were there the day John Deeres engineers were running some tests on it to decide whether or not they were going to buy this machine for manufacture. And that was the day they bought it.

Bainer: Well, Claude Waltz was working in a much more friable soil than we have in California, but he was using skeleton wheels that were tapered so that the face of the wheel had about the same angle as the taper of the sugar beet. The sugar beet is a conical shaped root, and these wheels came right along the side of the sugar beet, and they converged at the back. As they rotated they had a tendency to squeeze the beet and pop it up out of the ground, with a minimum amount of soil. That's what they're using today. If you go out and watch a sugar beet harvest around here now, you'll find a beater or scalper that practically destroys the tops, so they have no value for feed. Following top removal, the wheels pop them up and away they go to the factory. And so it makes you think, "Why all that tremendous effort twenty-five years ago to do what we thought had to be a perfect job, and now the fact is, that they accept anything." It all hinges back to the processing. In the early days they didn't have equipment at the factory to take off leaf streamers and separate trash. With present cleaning equipment, they could practically run the beet in there with all the leaves on it, and still, by the time it got into the slicing knives it would probably be all worn off.

AGRARIAN ADVISOR TO NATIONS:

England, 1945

Dickman: As a result of your expertise in sugar beets you were invited to England in 1945?

Bainer: That's right. I don't know about my expertise, but I was invited to England. This is kind of an interesting background. In 1940, the British Sugar Corporation asked the Minister of Agriculture to send the director of one of the experiment stations in Norfolk to Davis to see what was going on in sugar beet mechanization. And, of course, we had only been in this thing a couple of years, but there was enough going on to impress the man. And, of course, we were a bunch of upstarts here and we unfolded for him sort of a five year plan -- where we hoped to be five years from then.

Anyway, he went home and told the board of directors of the British Sugar Corporation about his trip to Davis and who he'd met and what their plans and expectations were, that they planned to have this crop mechanized by 1945. According to him (and I spent some time with him later on) they more or less ridiculed his report because there'd been too many people who'd worked on this problem for too many years, and to think those guys could do what they said they were going to do in five years!

Well, things went along pretty well and things were accelerated, of course, due to the war, and information was released probably before it should have been. Nevertheless we were in an emergency and it was a matter of gambling at times, in order to save an industry. And so five years later the British Sugar Corp. sent him back to see how well we'd gotten along. His name was Frank Raynes, and he was probably one of the most outstanding Britishers I met. Raynes was here for several days, and we had him talk to the faculty club one Friday night. He made a marvelous talk about how the Britishers were eating directly off the land rather than through livestock. By that I mean an acre of potatoes would go a long, long way to feed a lot of people. They were feeding direct on potatoes and cabbage and sprouts and the like.

Well anyway, he went home and made his second report, and the next thing I knew Dean Hutchison called me from Berkeley and said that he had a request from the British government to borrow me for a three months period to go over and visit their sugar producing areas and meet with their people and tell them of what we were doing. I remember Dean Hutchison asked me on the phone if

Bainer: I'd like to go. He wanted me to go. I said, "Well, I wouldn't turn a thing like this down." Even though the war was still on, in Europe. This was in winter, that I got this invitation, and they indicated they'd like to have me over there about April. Well, anyway, I made all the arrangements to go --

Dickman: That was April of '45?

Bainer: April of '45. The arrangements from this side were made through the agriculture attache in Washington, and he called and asked me if I would mind going over with the ferry command. They had a B-24 that had been equipped with about a dozen bucket seats, and this plane was used to ferry our pilots back from England.

So this plane was always going to England empty, but it would be full coming back. So they were trying to save money, naturally, and they asked me if I would mind going in this manner. Which was all right. I mean, these people were doing it every day.

Dickman: Was there much concern for your safety?

Bainer: No, I wouldn't say there was. There were three congressmen from the United States, the editor of the London Times, and a general from the Canadian army on the plane. It was a real high level group. Well we had problems. We were to take the plane at Montreal. After we had started on a non-stop flight to Prestwick, Scotland, we developed engine trouble and returned to Montreal. I remember we had to fly for several hours to burn up gasoline so we could land safely. And this broke my heart [laughter] because I was only getting four gallons a week on an allotment and here was a plane trying to reduce it's weight by burning up gasoline. We had nine tons of gasoline on board when we started, and I don't know what we had to reduce to, but we had to fly and fly. I sure saw a lot of the Montreal area from the air. Well, we came down and we were taken back to the hotel and put up for the night. Twenty-four hours later we were due back at the airport to start a second time.

This time, they said we were to fly to Dartmouth, New Brunswick, Canada and then continue from there. We landed at Dartmouth, and after having dinner we loaded up to take off and we were in and out of that plane all night. Something happened everytime we went out. Finally at the break of day the next morning, the pilot, our flight captain, said, "Gentlemen, I always insist on having four good engines when I start; I may not have them all when I get there but they have to be good when I start. I've made 119 crossings and I just refuse to fly this ship." And we all said that we were behind him. [Laughter] So the problem

Bainer: was, in that crowded military camp, to find a bed. We hadn't been in bed, you see, all night. And we were going to have to wait for another plane. Fortunately, we had this General from the Canadian Army, and he said, "Just give me thirty minutes and I'll find a bed for everyone." So he called an anti-aircraft group that was about 8 miles outside of Dartmouth and they had beds and we all went to bed and slept 'til about five o'clock and had a big steak dinner and came back to the airport and there was another plane there and we took off. And it was a non-pressurized cabin. We had to fly at 16,000 feet so we had to take oxygen throughout this trip. It was a cold miserable night; snowing.

Dickman: Was there much heat in the plane?

Bainer: No, we couldn't have any heat until we were airborne, and by that time you were frozen because there was nothing but that thin shell of aluminum between you and outside. But we made it to Prestwick without any difficulty.

Dickman: Use your oxygen much?

Bainer: I did for a while, but after a while, I reasoned that I had climbed mountains that were over 14,000 feet high exerting myself, on three different occasions. And I thought, well, if I could walk and carry my weight and get along at 14,000 feet I ought to be able to sit there at 16,000 feet and not be bothered, so I told the fellow across the aisle from me that I was going to take off my oxygen mask and for him to watch me. We were to watch each other. So I took it off and had no ill effects so pretty soon I suppose half of the passengers were flying without the oxygen.

One of the interesting episodes of this trip was the fact that we had on board a member of what was known as the Short Snorters Club. This was made up of people who had flown the Atlantic. And this, of course, wasn't too common in those days, and the idea of the club was that anyone who was a member could assess all the non-members who were on this flight $1.00 a piece in order to initiate them into the Short Snorters. Well, this fellow didn't have quite that much nerve, but he wanted to be sure that we were all members of the Short Snorters Club so we went through the formality, and I have a dollar bill that I've carried around all these years that has the names of all these initiates of this flight's Short Snorter Club. Well, it wasn't long until so many people were crossing the Atlantic that this activity just disappeared. I mean you never hear anything about the Short Shorters now, but this was quite the thing to belong to in 1945.

Bainer: Well, we came into Britain early in the morning when the sun was just breaking through the clouds. We looked down on Northern Ireland and Scotland, I don't think I ever saw a more beautiful sight. I suppose I was ready to land by that time, but the lush growth of grass and the greenness I observed at the breaking of the dawn was really something I'll never forget. Came into Prestwick OK, and there wasn't any air transportation available to London, so we had to wait in Prestwick all day, and take a night train down to London. This was my first experience on a British railroad. I had a little compartment, and one of the things that I noted immediately was the fact that no towels were furnished. I remember I had shaved and was cleaning up and I couldn't find a towel so I asked the porter if there was a towel available. He said, "No, during the war we don't have any towels. You'll have to use your pillowcase." And so that was my first introduction to the fact that I was going to have to carry a towel every place I went. A wet towel in your suitcase permeates your clothes.

I landed in London, and I had seen a map of the area of London where I was supposed to report. It was pretty close to Downing Street. I asked a chap on the train how he would suggest I get down there. He said, "Oh, you'll have to take a taxi." "Of course," he said, "the underground runs down there, but you're not familiar with the underground." I went outside the station and there was a queue about a block and a half long waiting for taxis. I thought I'd better go down and take a chance on the underground. So I went down into the subway, and the cars had maps that showed just where this line ran, and I got off at the right place. When I came up I didn't know which way to turn. There was a paper boy at the exit and I asked him how to get to this address, and he took me out to the curb and directed me, and there was a circle in the street, and when I saw that circle I knew exactly where I was on the map. I got to the office before the man that I was to see was there. And his secretary said, "He won't be in for another half hour." I hadn't had any breakfast. I remember going up to the corner and finding a little restaurant. I had some sausage. It was adulterated with something. I don't know what was in it, probably a lot of cereal. It was a meager breakfast but it was filling.

This fellow I was to see was from the British Sugar Company, and he just couldn't believe that I could get from the railroad station as quick as I did, being a stranger. Well, I spent the day in London. That afternoon we were having a meeting with some of the people in the sugar company and the War Production Board. Frank Raynes who I mentioned had been at Davis, was to

Bainer: come in for the meeting, and he then was to take me back to Sprowston which was near Norwich, and I was to spend the weekend at his home. (I'd lost half a week getting there.) So, we arrived at Norwich that night and I spent the weekend with the Raynes and found them very hospitable people. They had five daughters, I remember. The youngest was the same age as my daughter and I introduced these two to each other by mail, and they have corresponded ever since. That was in 1945 when they were eleven years old. Just as a sidelight, when Judy Raynes was going to get married in '56, she wrote to her pen pal, my daughter, and said, "I'm going to get married and I'd sure love to have you here for my wedding." My daughter hadn't told her that she was planning a trip to Europe that summer, and she wrote back and said, "I'll be there." And she made it! And, I tell you, the highlight of my daughter's trip was to finally meet her pen pal and attend her wedding. She even rode on the train back to London with the bride and groom. They were going to one of the channel islands on their honeymoon.

Well, Monday morning I was to leave Frank Raynes and go up to York. Outside of York, at the little town of Askam Bryan was the National Institute of Agricultural Engineering. This institute at one time had been adjunct to Oxford, and for some reason or another the connection broke down and they were looking for a new location and this little agricultural School at Askam Bryan had just been built. The war came on and there wasn't any money or staff available, and they weren't going to be able to open this school until after the war was over. So, the National Institute of Ag Engineering moved up there and occupied this school which had a dormitory, classrooms, library and shops, and it was very adequate for this institute to operate out of.

I spent most of the week there, and this was to be kind of a headquarters for me while being involved with the British Sugar Corporation. On Friday of that second week we were to have a meeting with the British Sugar Corporation executives at Peterborough which was, I suppose a couple hours drive from Askam Bryan. During the meeting, an itinerary was worked up for me to spend some forty days visiting and discussing our results with the sugar people and farmers in every sugar producing area in England and Scotland.

Again, as a sidelight, at the end of the day I was told by the director of the British Sugar Corporation that every effort had been made to find me a room at the hotel in Peterborough for the weekend. They'd failed. Hotel rooms were very, very scarce, as I found out later, and I had two choices: one, I could go back to Askam Bryan: the director of the Institute of Agricultural Engineering was in the United States and he had

Bainer: what they called a flat in the dormitory, a little two room apartment, and I was to occupy this while he was away. The other choice was to accept an invitation to spend the weekend with an agriculturist Oswald Rose who was with the British Sugar Corporation who lived west of Peterborough in the little town of Ramsay with his father. They had a cook, so there wouldn't be any imposition. He had called his father and told him I was stranded, and his father said, "Well, bring this fellow home with you tonight."

So, after dinner, we drove out to Ramsay. His father met us at the door, and after we shook hands (I found this gentleman was in his mid-eighties), the first question he asked me was "How big does an orange tree grow?" He knew I was from California, and he wanted to make some conversation. [Laugher] So, I told him. Well, the second question he asked me was, "What are you going to have to drink?" I said, "Well, I'm not particular about having anything now." We'd just had dinner, you know. He said, "Well, you know, I have my father's cellar." Here was a gentleman in his eighties, and he had some of the remnants of his father's cellar. He said, "I've got some Spanish sherry down there, of the vintage of 1880, and I've got some 1883." He said, "I believe the '83 is better than the '80." And I said, "Well, I've never had any sherry wine that was that old." [Laughter] And I didn't even believe it could be that old at the time. He went down and got a bottle of that '83 sherry, and I'm telling you, it was just out of this world! When I got back to Davis I looked into this and found out that sherry wine, properly taken care of, would last that long.

Well, anyway, I had a delightful time, and then, of course, I spent some time with Oswald Rose. Well, we started in visiting some farms in the sugar company areas. The Sugar Company had acquired seed segmenters built by Blackwelder. I had already started on the decortication method, and of course I carried samples of whole seed, decorticated seed, sheared seed, burred seed with me. (Not bird seed you feed birds, seed sent through a burr mill). And, this was planting time, you see. I was over there just at the time they plant sugar beets. I was taken out to see many stands of beets from segmented seed and talk to the farmers. And they were having the same beginner's luck with some of this stuff, that we had had. It looked very promising to them as a labor saver. Well this sort of thing continued for the next forty to fifty days. I think there was a period in the middle where I spent ten or eleven days at Askam Bryan at the National Institute giving seminars and studying their operation, and also trying to bring my reports up to date.

Bainer: But the fact that sugar beets were grown all over England and much of Scotland gave me a real opportunity of visiting this country really in detail. I visited every factory district. I've forgotten how many there were now -- ten or twelve, and they spread from Chichester on the English Channel to Cooper, Fifeshire which was up near Aberdeen. Gasoline rationing in England was as severe as it was in the United States, and as a result, the field men that I travelled with in a particular district could not leave the district. They had to stay within certain geographical bounds. The visits had to be coordinated to the extent that I was taken to the boundary by a field man and met there by the field man in the next district. And so I simply transferred my bag to another car and off we went. And in the whole travel we never missed connections except once. And I mean right on time. If the connection called for two-thirty everyone was there and the transfer was made. When we reached Stratford on Avon (Shakespeare's country), we were supposed to meet in front of a hotel of a certain name. There were two hotels in Stratford by almost the same name, but they were on opposite sides of the Avon River. We pulled up to the hotel where the fellow thought we were going to meet the other party and we waited, and we waited. And the other party was at the other hotel and they were waiting. Finally this fellow got worried. After all, he thought there might have been an accident or something, so we went in and had dinner. Well, after dinner the other party thought, "Well, maybe they're over at the other hotel." And he came over and here we were. That was the only time we missed connections.

When I made a long jump, like from one of the sugar districts in England to one in Scotland, I did that by train. There was quite an area where no sugar beets are grown, so there was no chance of making it all by automobile. I went into Edinburgh by train and was met there by McCloy who was the manager of the Cooper District in Fifeshire. The beautiful part about travelling with these people was that each one of them felt obliged to show you something of interest in his district even though it wasn't sugar beet mechanization. And so McCloy decided we'd go to Saint Andrews for dinner. And of course when you go to Saint Andrews everybody's got to show you the old golf course where the golf game originated, so we walked out over that course. It was a cold, blustery night. The wind was blowing and it wasn't very inviting to think about playing golf. But McCoy just had to take me down the path that Bobby Jones had trod. He mentioned that Bobby Jones had cut quite a figure when he was over there playing that course.

Dickman: Did it look like a tough course?

Bainer: Oh, yes! If you got in the rough there you couldn't even find your ball. I tell you, it was the roughest rough I ever saw. After this we went to McCloy's home. He said, "I hope it's all right. We have a guest room and we'd like to have you stay in our home." This was the beginning of many overnights in the homes of the people I was working with. Well I remember we got to his place about 11:30 at night. They had two hours daylight saving, and that far north, in the summer-time you could read a newspaper at 11:30 at night outside. I couldn't get over how light it was. Well, I enjoyed Scotland. We visited a big farm, belonging to John Mackey. He's now a member of Parliament.

John Mackey had a beautiful farm. I had been told that the weather would be foul when I was in Scotland, that it rains all the time that time of year, that I wouldn't enjoy it etc. But I never saw such beautiful weather all the while I was in Britain. John Mackey even had a tea at four o'clock for all the neighbors and friends out on his front lawn. It was a beautiful occasion.

Well anyway, I came back to England. One of the things I failed to mention was, in lining up this visit, the British Sugar Corporation had arranged for me to spend a part of a day and a night with a key farmer in each area. And I think this was the outstanding feature of my trip. They picked people, gentlemen farmers, most of them, either a farmer of somebody who was related to agriculture like a seedsman or a market gardener, etc. So, each week I had this delightful experience of spending a night with a farmer and always in his home. The war was on when I arrived in England but V.E. day arrived soon after I arrived. (I saw the craters of the last V-bombs that landed pretty close to Buckingham Palace.)

So many people who had been bombed out of their homes were living in hotels that it was very, very difficult to find rooms in the hotels. So 2/3 of my nights in England were spent in the homes of the people I was working with. I remember one outstanding experience was with a market gardener by the name of Secrett, down south of London. He had four different farms, and was growing vegetables for the London market.

He had an irrigation system. He had a lot of almost crackpot ideas, I thought at the time. He used a sprinkler system for irrigating vegetables when it got a little dry. Of course you don't have to do a lot of supplemental irrigation in England. He insisted on heating the water, to keep the vegetables warm, to take the chill off, and also of mixing his fertilizers with this spray so that he was feeding the plants through the leaves.

Bainer: As I say, he had a lot of theories that weren't agreed with by scientists in England.

Dickman: How about his yield?

Bainer: Oh, he was making money hand over fist! He tried to force certain things on his clientele. For instance, he'd been to the United States and he just loved solid heads of lettuce that came out of the Salinas Valley, for example; iceberg lettuce, I guess we call it. It's a very firm head of lettuce and the British don't eat that kind of lettuce. They prefer a leafy lettuce that is prepared by wilting. Secrett put in a little iceberg lettuce. We visited the field and saw his operation. He handed me a head of lettuce and said, "What's wrong with this head of lettuce?" I said, "Well, nothing that I can see." And I was just breaking it apart and eating it. I mean, I was so hungry for lettuce, I hadn't had any since I left home. He said, "What's wrong with it?" And I said, "Nothing! This is absolutely out of this world. I'ts just as nice a head of lettuce as I ever saw in the Salinas Valley." He said, "That's what I thought. But," he said, "I take a crate of this lettuce to the store every morning and the next morning it's still there. Nobody'll buy it and I just have to bring it home. I've just got to believe I can sell this kind of lettuce in England." Many G.I.s wanted sweet corn and sweet corn isn't eaten in England, you know. [Laughter] He started growing sweet corn especially for the G.I.s at two-bits an ear. He made so much money he finally gave them two ears for a quarter, [laughter] the English money equivalent. He was a character, really. I remember him going up to a filling station to put a little gas in his car, and the first thing he asked the attendant if his petrol was fresh. [Laughter]

Well, there were several highlights on this whole trip. Of course, I was traveling with the sugar industry people who were well-known and I was accepted every place I went. I never felt any offishness or any resentment at having me around. I'd been told by some of my friends in Davis who had been in England who tried to prepare me for what I was going to run into. Well, they couldn't have been any further wrong than they were. They told me that I wouldn't be accepted, that I'd meet reluctance and snobbishness and all that.

Well, one visit was to Lincolnshire where the Sugar Company had a plant at the little town of Bardney. And the manager of this plant named Max Howard had his wife with him when they met me down at the little town of Sleaford when we made one of those transfers. When we reached his house he said, "That's where I

Bainer: live." It was back at the end of a tree-lined lane. I thought, "well, he's going to drop his wife off here." I had reservations at a very nice hotel in Lincoln, and I was looking forward to this weekend, because this hotel had been built for tourists and had some heat in it. You know, it was pretty cold in some of the hotels in England during the war. When we got to his house, he unloaded my bag and said "My wife and I thought we'd like to have you spend the night with us." We're having some of our friends in tonight for dinner." Well, what wore me out was all of this entertainment. Everybody who entertained me felt they ought to have some guests in to meet this American and we'd sit there and talk til midnight. Well, it was a very delightful evening. He had a nice family and his mother was living with them. The next morning it was pouring rain and he fitted me with a pair of rubber boots and walked me over the farm. We got back to his house around eleven and I thought, "It's Sunday and he'll probably take me up to the hotel this afternoon." But he said, "You know, we were so pleased with your visit last night we just called the hotel and canceled your reservation. We want you to stay with us while you're here." So I was with this family for about four days. Well, this happened everyplace I went. I mean it was just a delightful experience.

On Monday morning we drove up to the sugar factory. And here on the flagpole was the stars and stripes. And I looked up there and saw the American flag flying on top of the sugar factory and not even a British jack up there (we fly some other flags here but with our stars and stripes up on top). I said, to him, "Listen, you don't regularly fly the American flag here on your sugar company?" "Well," he said, "we do it when we have important visitors like you." And I tell you [laughter]-- that's about the most touching thing that's ever happened to me. That guy was flying the American flag in my honor, and it flew on that factory all the time I was there. I had some great times with him, and we've corresponded, and unfortunately about a year ago he passed away.

Dickman: What kind of soils are in England?

Bainer: Oh, some of the most miserable, rocky soils I've ever seen. I don't know why I thought "That England is an old, old country, and probably all the rock and stone has been disintegrated you know, it's been worked so many times." Well, they have beautiful soils in some areas. The Fenn district was beautiful peat soil. And up around Boston was beautiful loam soil. But in general, the soil is intermingled with rock, little stones. And you can pick up all these stones today and in another week they seem to work to the surface. So, they're farming in the stones and growing sugar beets in these stoney fields.

Dickman: How does the yield compare with ours?

Bainer: Oh, it's higher on the average. And this is true for the grains, too. They maintain yields very well. They do a lot of fertilizing. And while these soils had all these stones in them, they would still be very productive.

Dickman: Did they use natural fertilizers?

Bainer: Yes, quite a bit, and of course, artificial, too. The feed yards where they fatten up the beef animals provide a manure factory along with it. The manure which they call dung is used for fertilizer. They make great use of it. In this country we're told that it isn't valuable enough to pay for hauling costs. Well, we're going to have to haul it whether we want to pay for it or not, we are going to have to dispose of it.

I went to Rothanstead on one of my visits. It is one of the old, old experiment stations. It was a station that I heard quite a bit about as a student in college when I took courses in soils and farm crops. The professors who taught those courses maybe hadn't been at Rothanstead, but they were familiar with the results of many of their experiments. I suppose the one that was the most interesting to me were the plots on which they'd grown wheat continuously for a hundred and eighteen years at that time. Inasmuch as I'd been a wheat farmer in western Kansas and I always wondered when the fertility of that land would run out (we didn't do any fertilizing when I was growing wheat, we didn't have enough water to work it into the soil).

Well anyway, I went up to Rothanstead. And Russell's son, I think, was there. Sir Russell was the old director, and I think his son was on the staff at the time. And they asked if there was anything in particular I wanted to see? Well, again it was just pouring rain (I got used to that), and they fitted me up with some boots and young Russell walked me out to these plots. I wanted to see where the wheat was grown continuously. And here were plots which showed that (and I'd seen the curves) the yields on these plots from the beginning gradually got less and less, from year to year until they leveled off at about eleven bushels per acre. It was still at this leveling off stage after a hundred and eighteen years. But they now were having weed problems and were having to fallow this land to get rid of the weeds. They didn't want to use any chemicals so that they weren't growing wheat every year now. It's grown about three years out of five or something like that.

Well right along side of that plot were plots that had been continuously in wheat for the same length of time, but they had

Bainer: received ten tons of barnyard manure per acre every year. The yields went the other way, and finally up to around 25 bushels per acre and leveled off. All it was receiving was just ten tons of barnyard manure per acre. That's a lot of manure, but they were maintaining -- had actually improved -- the fertility level of that field to a certain point and then, as I say, it leveled off.

Dickman: Did you meet any ag engineers over there?

Bainer: Yes, I did. The National Institute had about 30 ag engineers on their staff and they were doing some rather interesting work -- much of it of a testing nature -- testing farm machinery. They had fields for plowing; I mean things that had been done here many years before. There was some development going on of different types of special tools. They were even working on a sugar beet harvester. Interesting to me was that this staff of 30 had about a hundred technicians to do the work for them. No one gets his hands dirty in this kind of a job in England. You always had somebody to do all the mechanical work and dirty work. Every man had about three technicians, and I can remember a little later on when some of these fellows came over to see us. I'll relate that story in a moment. -- You see, after I was there, I suggested that the British Sugar Corporation and the National Institute of Ag Engineering send some people to the United States. We were making rapid progress in the United States on sugar beet mechanization. They had attempted and succeeded in producing all of Britains sugar needs during the war, and this amounted to 71 pounds of sugar per person, per year, which was all they could produce. I had to go to England to find out why we in the U.S. only got 71 pounds of sugar per person. During one of the visits between Roosevelt and Churchill the latter mentioned that they were getting along fine and they had enough sugar in England to give every person 71 pounds per year. And Roosevelt said, "If that's all you're going to have, that's all we'll have in the United States." So, we were cut back to 71 pounds per person per year, and that's how we got that quota. And this just made me furious, because we had plenty of sugar available. But this was kind of a sympathetic move. I never heard that explanation in the United States. I had to go to England to find that out.

I mentioned that I felt that at least a couple persons from the National Institute and a couple from the British Sugar Corporation should visit the United States and see what was going on in mechanization. They came directly to Davis, and I arranged their trip through the sugar country where beets are produced. They came to California because we were earlier in our harvest

Bainer: than the rest of the country so they could observe harvesting when they got here. I remember taking one of these fellows from the National Institute with me down to the Clarksburg area where the International Harvester Company had put one of their prototypes of harvesters with the farmer. (Just gave it to him and let him operate it free in order to get some mileage on it.) This particular unit had been based upon the work that Armer had done at Davis. The interesting thing was that this fellow from the National Institute had been with what is the equivalent of the Bureau of Standards -- he wasn't an ag engineer, he was a scientist. He was surprised that I changed my clothes. I had put on my working shoes and my kakhi pants. When we got down there, they were having some trouble with the machine so I crawled underneath it and suggested a change. They went to the shop and changed the shapes of shovels and came back and apparently corrected the problem.

Well, this harvester had a trailer for receiving the harvested beets, which held about a ton and a quarter. They had a truck in the field to receive beets from the trailer. They had a five ton load on the truck when we arrived. That particular day two men were operating the machine, so they were going to stop harvesting and run the beets into the factory which was only two or three miles away. So I said, "Well, you fellows keep running the harvester. You've got a capacity of a ton and a quarter of beets, and I'll take these beets into the factory. I'm sure my friend here from England would like to see how these beets are handled at the factory." He agreed.

Well, we drove that truckload of beets in and went through the weighing, sampling, and dumping the load. About half way back to the field the truck engine stopped. I had had a little experience with that truck and I knew more about it than my friend realized. It had a gravity feed from a gas tank under the seat and I figured there was a foreign object in this tank that would once in a while get over the outlet. So [laughter] I disconnected the pipe at the carburetor and blew back through it and opened up the line. Then the engine was started and we drove off. On the way home he said, "This day has been amazing to me. You're a professor at the University of California. The first thing you did was to crawl under that machine and tell them what's wrong with it. And then you knew all the idiosyncrasies of that farmer's truck." He never got over that day.

John Mackey and two others from England came in here a little ahead of the sugar company fellows. They wanted to see farm structures. Mackey was getting ready to build a new dairy barn so I asked Herbert Belton to take them to visit some modern

Bainer: dairies. They went out to John DeCarli's place near Stockton. He'd built one of the first elevated barns where the milkers work in a pit and the cows come through on an elevated platform so that their udders are right handy to milk -- you just reach in and put the milking machines on the udders. You don't have to bend over.

Well, Mackey saw this modern milking barn and he came right back to Davis and sent a cablegram to his farm manager and said, "I just saw something. I don't want you to go any further with the construction of that dairy barn. Stop everything until I get home." So he held up construction till he got home so he could modernize it.

During the war, food was pretty scarce in England and it was pretty bland as far as I was concerned. I had cabbage at least one meal a day and sometimes two, for the first 41 days I was in England. These fellows came in here from England and Belton picked them up at the hotel and started for the field. They hadn't had breakfast so we stopped at the Nut Tree to have breakfast. And the boys, of course, ordered bacon and eggs, they hadn't had any eggs because during the war the slogan was one egg per person per month, -- if you could get the eggs. One egg per person per month! Of course a lot of people found out how to get more eggs than that, but this was the standard ration. Belton said, "You know, these fellows asked the girl very sheepishly if they could have three eggs with their bacon." Well, if you've been without the food that you're used to, it sure is a treat to get back to eating plentifully again.

Dickman: How about the cows in England? Did you see any white faced Herefords?

Bainer: Oh yes. That was really something. I was traveling with one of these sugar company representatives in Herefordshire. That is, of course, the home of the famous Hereford cattle, which some call white faced cattle. We were driving along this beautiful road with pastures on both sides and here was this beautiful herd of Hereford cattle out there in grass way up to their bellies. It was quite a pastoral scene. And the fellow said, "I drove through here last week. I had picked up one of your G.I.s from Texas. And that same herd of cattle was in that field. What do you suppose that Texan said to me? 'Huh, I see you've got a lot of our white faced cattle over here.'" [Laughter] And this was just about as much as this fellow could stand -- the ignorance of this Texan who didn't know where his white faced cattle originated.

Bainer: A general assembly of men from the various sugar producing districts was held in Peterborough at the end of my stay in the British Isles. I gave them the results of my observations. I prefaced my remarks with the statement that I had made to many of the men I had traveled with -- I am seeing England and Scotland as few Americans have. Now I can say I have seen England as few Englishmen have.

Well, it was time for me to leave England and return home. We started out from Pool, and flew to Shannon for refueling. We landed on some pretty rough water in the River Shannon which gave me my first experience of how hard the water really pounds a flying boat when they land and take off. We flew the northernmost route which was only about two thousand miles from Shannon to Gander. And it was one of the most comfortable trips I ever had. We flew, -- not too high, I don't suppose we were flying more than eight or ten thousand feet. There wasn't a breath of air stirring. I slept like a log. All of us had lower berths, and we arrived in Gander the next morning. And you never saw such an array of food; buffet style. They were frying eggs and had bacon and ham, and fruit juices and these people who had been on austere diets in England for years, and even I only for three months -- I'll tell you, this food was a magnificent sight. I bet some of those people ate half a dozen eggs. I've never seen anything like it -- they were just starved. We took off from Gander and landed at Baltimore. There was a young chap on the flight that I had bunked with at Pool. We had gone down to Pool the night before and we were assigned to bunk with someone; there were two beds in each room. And this young fellow was from the Isle of Mauritius. Well, I had no idea where the Isle of Mauritius was, but I wasn't going to show my ignorance. On the wall of one room on this flying boat was a map of the world. And I said, "Well, how did you come into Pool?" And, of course, he had to start out at Mauritius. [Laughter] I found out that Mauritius was way out there in the Indian Ocean.

Well, this chap was on his way to Trinidad. We landed in Baltimore, and were taken to the Lord Baltimore Hotel. That night we went to dinner, and they had a big menu with about 25 or 30 entrees on it. He said, "Do you mean that if I order anything on this menu I can expect to get it?" I said, "Well, try! They print these up every day." He couldn't believe it.

After dinner I said, "Let's go out and do some window shopping, just to get out and get some exercise." We had been on the flying boat all night before. As we walked along I said, "Do you know what I'm hungry for? I'm hungry for a chocolate milkshake."

Bainer: Well, he'd never heard of a chocolate milkshake. I said, "Well, I'll buy you one. You can have your first one." We went into a drug store and they had plenty of milk but no ice cream. So we went on up the street and came to a Borden Bar, and we went in and ordered a chocolate milkshake. They had ice cream but no milk. So, I said, "Just bring me a chocolate sundae." And he said, "Do you think I'd like one, too?" I said, "You probably would." They were only ten cents. He couldn't get over that. He just couldn't believe that that much goodness could be bought with the equivalent of a sixpence.

So the next morning he got cleared to go to Trinidad before they could clear me on transportation to the west coast. I told him, "Let's have lunch together and I will take you to the railroad station." He was going to take a train to Miami and then fly to Trinidad. So we were sitting there at lunch and he said, "You know, I have a confession to make to you." And I said, "What is it?" And he said, "You know that thing we had last night? I went back and had another this morning." [Laughter] He felt guilty. He actually felt guilty.

Japan, 1948

Dickman: Well, three years later you went to Japan. It would be interesting to talk about that now.

Bainer: It was also a very interesting trip. I thought I'd never have any experience that would excel the experience I'd had in England. In Japan, I was on my own everywhere I went.

I flew with MATS in a C54 which was the equivalent of the DC-4. We started from Travis air base and flew to Honolulu. After spending the rest of the night at Hickam field, we flew to Johnston, refueled and then to Guam. There was a typhoon between Guam and Tokyo so we had to wait until it passed before we could go on up to Tokyo. Well, I don't know what the total elapsed time was, but the flying time was 38 hours.

Dickman: What time of the year was this?

Bainer: This was in April.

Dickman: Of '48?

Bainer: Of '48, yes. I flew with the military MATS. All the pilots, except the captain, were just kids; young kids. I never got over the precision with which everybody worked. They would give us the expected landing time and wouldn't miss it more than five minutes on those long hops and some of them were eight hours.

I was invited to Japan by General MacArthur. A telegram came from him asking if I would come as a consultant to their National Resources Section which included agriculture. I had no idea other than he said that he wanted a study made of the possibilities of mechanization in Japan; agricultural mechanization. And that I was to report to Colonel Schenk. Colonel Schenk headed up the National Resources Section. He was on leave from Stanford University where he was a professor of geography, a very fine man. Highly educated and well-qualified and doing a good job of organization and getting the Japanese back on their feet.

When I reached Tokyo I was taken to the Dai Ichi Hotel. My civilian rating was P-8 which was equivalent to a full colonel. This was pretty important for getting around Japan.

My first morning there I reported into the office and I was told that Colonel Schenk would like to talk to me. I went into

Bainer: his office and found him a very congenial, good listener and good conversationalist. And after a few pleasantries talking about California and finding he was from Stanford and I was from Davis, we got down to business. And the first thing he said to me was "I don't know really why MacArthur insisted upon having you here. I don't know what you're going to do. I can tell you a couple of things, though. You're not to suggest anything to change Japanese agriculture that would put anybody out of work and you're not to suggest anything that uses petroleum products." I said, "Well, I may just as well go home tomorrow. I don't know what we're talking about." "Well," he said, "I don't know either." He said, "I do know that MacArthur is quite concerned about the raw material that has gone into the manufacture of small tractors, and these small tractors are delegated to fence corners within two or three weeks after they go to the field. They just don't run, but they continue to make them. I think the thing to do is to get you in the field and let you study what's going on." And that's all the instruction I had. He said, "We have a man in the field at Sendai right now, from our agricultural group, and it would be very simple to attach your trip onto his orders. In other words, you'll be attached to him, to his orders, and that will get you to Sendai the first of next week (This was on a Thursday I met with him) and we'd like to have you up there Monday morning." And then he told me that I would report to Captain W. O. Adams who was the economics officer in the military government team at Sendai.

Well, I went up to Sendai. They insisted that we ride night trains. They didn't want us wasting our time, you know. But I insisted I wanted to ride the day train to see the country and I did. That was a magnificent trip from Tokyo to Sendai.

Dickman: Was it a special car for Americans?

Bainer: No, it was a special train. They had the Yankee Limited that went north from Tokyo to Amori and the Dixie Limited that went from Tokyo south to Kyushu Island. And these were all Allied trains. No Japanese could ride. And they had a white stripe painted the full length of those trains, right in the middle of the cars. And the Pullman cars were named for cities in the United States. They were sleepers just like ours, but they were very small compared to ours. The berths were just one person wide; upper and lower, and then they had compartments. They had dining cars. They were run by the Japanese for the Allied forces.

Dickman: I don't suppose you could compare them with the Bullet trains now.

Bainer: Oh, no. But they did run on time. When you got off onto other lines, when for instance, when you wanted to go on the Japan sea side of Honshu Island then you had to take another train and all they had there was just one car, which was only for Allied personnel. And only once, and this happened in Kyushu, I rode an Allied car and was the only one in it, the whole length of Kyushu Island. Well, I remember one time I was getting on a train in Niigata and they didn't have an Allied car. The station agent cleared out two seats facing each other at the end of the car for my exclusive use.

Dickman: Why this separation, were they afraid of incidents?

Bainer: I don't know.

Dickman: Or was it a sign of respect?

Bainer: I think more or less it emphasized respect. I know that the train became crowded and I invited people to sit in the other seat. They appreciated it, too. Well, anyway, I went up to Sendai and I was told that I would be housed in the officers club. This was the good thing about all my experiences in Japan, I knew where I was going to stay every night and I knew where I was going to eat. You had to eat in the officers club, every other place was off-limits.

I got up there Sunday night, and Earl Johnson, whose orders I was attached to, was one year ahead of me in college, so we both came out of ag engineering at Kansas State. He in '25, and me in '26.

Dickman: What a coincidence.

Bainer: Yes. So we'd known each other, you see, for years. They sent a car for me and I went over to the military government team early Monday morning, and walked in and was shown into Captain Adams' office. I got there before he did. I was sitting at his desk with my back to the door. So here comes Captain W. O. Adams, and much to my surprise, I looked around and there was Bill Adams, a student I had had in class at Davis before the war. How lucky could a guy be? This was my first field trip. I had made up a little schedule of operations. I put down a whole list of questions I wanted answered. It was a kind of a survey sort of a thing, and I told Bill, "You know, I'm really in difficulty. I'm out here all on my own." I went over some of the things I wanted answered. Well nothing nicer could have happened than to run into Bill Adams. He took two days off and took me under his wing, and he got everything organized for me and I got onto the ropes fast. And also I got to see much more of the area

Bainer: than I probably would if I'd been just on my own.

There were a couple of interesting incidents that happened on that trip. One was that we visited a small agricultural college in Sendai, and Adams, being from the college of agriculture here at Davis, had already spent some time over there. I was introduced to the headmaster, or the dean (I don't know what his title was). He asked Bill through his interpreter (Bill had a marvelous interpreter, a man who was probably in his seventies but knew English and Japanese and had a lot upstairs, you know) to have me speak to his class. And I told Bill (this was my first day in the field), "I know I'm not supposed to be visiting agricultural colleges and talking to classes. My job is entirely different." Bill said, "You know, you'll do an awful lot for me and my relationship in this community if you'll just get up there and talk to that group." So I did.

I got up on the stage and here was a room with about 40 students in it. As I stood behind the podium and I asked them what they wanted me to talk about, through an interpreter. And this was my first talk through an interpreter. They said they wanted to hear about rice production in California. Well, that was right down my alley. And I told them the story from beginning to end.

Dickman: You'd have to give a sentence and then --

Bainer: Yes -- well, you gave several sentences, really a paragraph and then it was interpreted. To start with, they didn't believe the "fairy story" that I was telling. I mean, I went into the large farming operation and the land leveling and the machines that made the levees. And then the use of the airplane for seeding, and the application of selective herbicides. Then in the fall sometimes we'd scare the water fowl away so we could harvest the crop. Sometimes these fields were covered four times by air.

Well, it was evident that they didn't believe all this stuff and they began to question it. This was a real sharp bunch of kids, and finally I guess they got it through their heads that I was telling the truth. One of the first questions was, "If you do it this way how do you control the weeds?" I said, "Well, we use selective herbicides and rotations. A field will only be in rice a couple of years and then go into tomatoes, alfalfa, sugar beets, or something else -- maybe barley." Well, they couldn't understand that there was any place in the world that didn't grow rice on the same land year after year. Because they had been growing rice on the same ground for four hundred years.

Bainer: They asked lots of questions, and at the end of the discussion they said, "You may do it this way in California, but do you realize that the yield of rice in Japan is one and a half times the yield in the United States?" And I said, "Yes, I know that. Interesting, also, the yield of rice in California is one and a half times the yield in the United States." And boy, I tell you that floored them, the fact that we were doing this -- and, of course, I didn't know what their labor input was then. I knew later, but I said, "We're doing this for about seven and a half man hours per acre."

Dickman: And their's was what?

Bainer: Nine hundred, I found out later. When I came home and had the chance to compare that year's yield (you see they weren't harvesting yet) and when the harvest was over that fall, we were within a bushel per acre of Japan's yield. But I think this was tremendous that they were back up in that yield class following the war, because it meant that they really had to build and maintain fertility and really get back in the harness to do this.

Well, one incident happened. I was taken to a small manufacturing plant where they made little reaping sickles and other hand tools. All the tools that were used in farming were hand tools. And there were six million acres of rice all harvested with those little sickles with the blade only six or eight inches long.

Dickman: No mechanization?

Bainer: There was a little in the threshing. I forgot to mention that I had gone to the PX before I left Tokyo, and I saw on the table some books on Japanese culture and so forth. One book intrigued me. The title was "How to Learn Japanese in Three Weeks." I knew that was impossible but I bought the book anyway. And as I rode up on the train from Tokyo to Sendai I had my camera ready to take pictures at anytime, and I was just shooting pictures out of the train window. I tell you I never took so many pictures in all my life. Beautiful, beautiful sights. And I also had this book in my lap, and the first pages told you how to count in Japanese. I had mastered the counting by the time I got to Sendai. I could count to a hundred in Japanese [demonstrates the first few numbers]. Well, we went to this factory and Bill Adams had told his interpreter that I had only been in Japan since Thursday, and this was Tuesday -- hadn't been there a week. I didn't know a word of Japanese and he had to be very careful because I had a very important position with General MacArthur, and I had to have definite concise

Bainer: answers. I asked the engineer in this plant through the interpreter what the carbon content of the steel was in the sickle. I had a good idea what it was. And, of course when they answered the words just came bang-bang-bang, you know, and it took him forever, but I picked out of the conversation S-A-N, san, and before my interpreter could give me the interpretation, I said, "Oh, 3/10ths of one percent carbon." You see san was three, and it couldn't be three percent or anything else, it had to be 3/10ths of one percent carbon. I knew enough about steel to know that's what it was and I filled in all the rest of it. Do you know that interpreter never trusted me from that moment on. I answered my own question and that was a mistake. But it was comical how I picked up S-A-N, and figured that was 3/10ths of one percent.

I had a very interesting session with the agricultural people in the Sendai prefecture. When I left Tokyo I fixed up a questionnaire. I thought I'd like to have answers to many questions, and I didn't know how to approach this other than to talk to the people and try to get a picture -- I wanted to get a picture of just what they put into their agriculture in the form of man and animal power, and what they were raising and what their yields were, and a breakdown of their operations. At Sendai, I attempted to do this, headquartering at the military government team, and they had the agriculture people from the prefecture come down there. This was the custom, to have the people come to the military government team headquarters.

Well, they came all right, but every time I'd ask a question, someone would have to go to the telephone and call back to the office to find out what the figures were, and at that time Japanese telephones certainly were not reliable. They wasted more time trying to get information over the telephone, and that taught me one lesson, that from there on I would insist on going to their offices in the districts where statistical information was available, and save time, rather than have them come to the military government team headquarters. This worked out very well even though the commanding officers of the military government teams criticized me because I insisted on making appointments at the Japanese offices.

After I'd collected this material, I took a trip over the mountains into another valley and I did the same thing and then went back to Tokyo and summarized all this data which began to indicate that labor requirements for production for rice were pretty high; in the neighborhood of eight or nine hundred man hours -- (I ought to say really women hours because the women were doing more field work than the men). This included land

Bainer: preparation, preparation of nurseries, planting seeds in nurseries and taking care of the nurseries and then transplanting the seedlings from the nurseries to the field, cultivation, insect control, and harvesting with the sickle and threshing, and so forth.

When I got back to Tokyo I summarized this data. I got quite a lot of information. I was finding the average size of operation to be around two acres, and not always in a contiguous field; the man might have two or three fields. I wrote this up, and I showed it to W. H. Leonard, who was head of the agricultural division, National Resource Section. (Leonard was a professor of agronomy at Colorado State -- the university at Fort Collins, and he was on loan to this group in Japan for a while). He suggested that I show it to Colonel Schenk, which I did. Well the colonel read it and we discussed it and he said, "You know, this is wonderful. This is just what we want." Even though he had said they didn't know what they wanted. "We'd like to have this sort of a study made in every prefecture in Japan." Forty-five prefectures, and I was only supposed to be there for two or three months. I said, "Now, this would be fine, but I don't think it's necessary, and furthermore, I don't have time to visit and work in every prefecture in Japan. I think if we take a good sample of Japan we can come up with equally consistent data." So, I suggested that I work in every third prefecture in Japan which would mean that I would work in a prefecture, jump two, and work in a third one and continue all the way down through Honshu and Kyushu Islands. And he agreed that that was what I would do.

He asked MacArthur's office to issue orders which made it possible for me to travel on my own. So I set out, and I would call the prefecture in the next location, the military government headquarters,and tell the commanding officer when I would arrive. I was traveling by train between prefectures, and I wanted someone to meet me at the station and make arrangements for me to stay at the officers club, and the next morning I wanted a jeep, a driver and an interpreter, and I wanted him to make an appointment at 9:30 or 10 a.m. with the prefectural people that were responsible for agriculture. And, of course, I always had to explain why I wanted to go to the Japanese offices rather than have them come to our headquarters. They usually had a conference room in the agriculture department, and at the appointed time I was there with my interpreter. The people in livestock, crops, and vegetables and other areas were around this table, and I'd throw out a couple of packs of cigarettes; everybody smoked cigarettes. The Japanese never turned one down. Whether they smoked them regular or not I don't know, but I had to have an extra quota of cigarettes. That just sort of

Bainer: relaxed everybody and we started in. Well, the interesting thing to me was that it wasn't long before my mission- what I was trying to find out- had preceeded me all the way down through Japan. And when I got into a place, the people knew what I was there for. So the grapevine, or the underground, was way ahead of me. I didn't really have any trouble getting information and the thing that amazed me the most, I think, (I was using a kind of standard questionnaire by that time so I wouldn't miss anything) was that the data that I was getting as I moved around Japan was consistent.

Well, I noticed several things. One was that there were quite a few of these small two-wheel garden type tractors sitting around. I never saw more than one or two of them that would run. They had tried them, and they'd broken down and were set aside.

Dickman: How were they powered?

Bainer: By a little gasoline engine.

Dickman: Made in Japan?

Bainer: All made in Japan, yes (they're very reliable now). I don't want to leave a wrong impression, but in 1945 there was a lot to be learned about metallurgy; they had trouble with valves, springs and ignition and what have you. And there was no service in the field. There was no place that the Japanese could go for help. And so I began taking the names down on these little tractors and found out that quite a few of them were built in Okyama prefecture which is south of Osaka. So I made arrangements when I was in Osaka to go down to Okyama and visit some of these manufacturers. And I found them very sincere. They'd like to see their tractors run but it was very evident after talking with them that responsibility for their tractor ended when it went out the door.

Dickman: No idea of service.

Bainer: No idea of service. And the thing I tried to impress on them -- they knew about International Harvester, John Deere, and Massey-Ferguson (Massey-Harris at that time), and I said, "How do you suppose they gained the reputations they have?" They had no idea, really. I said, "Well, they gained it by servicing the equipment they sold. You can go into a dealer's store in the smallest town in the United States and pick up common repairs that are needed, and if you need help installing them the dealers have a service man he can send out." "Well," they said,

Bainer: "all they have to do is send the tractor back to the factory and we'll fix it up." That's ridiculous, but they had that attitude.

After I had worked in every third prefecture I finally ended up in Tokyo. Of course I had been in Tokyo several times because of going first north and then south. I came back to Tokyo and I wrote a report. I tried to indicate just what the situation was. There was enough livestock to make about one animal available for every five acres, for instance, for pulling a plow. It might be a cow rather than a horse. The biggest surprise, I think, in the whole survey, was the fact that they had electricity all through this country. Every village had electricity. I estimated at the time that ninety percent of the people in rural Japan, most of them living in villages, working the area around, had electricity.

Dickman: And that was more at that time than in the United States.

Bainer: That's right. We didn't have that percentage in the United States. We do now, but we didn't then. They didn't have heavy lines. It was difficult sometimes to operate a motor, for example. Some farmers would go together and buy a motor driven thresher. Most of the early threshers were foot powered. It was just simply a revolving drum, with what would appear to be large staples driven into the periphery of the surface of the drum, and they'd just hold the rice against that drum as it revolved, and this roughness pulled the rice kernels off of the straw. They saved the straw because they make mats and rope out of it.

Well then, there were instances where more enterprising farmers would get together and buy a little thresher and a rope making machine that were powered with electric motors. And, of course, electric motors were used to power their rice milling equipment and some irrigation pumps. I was surprised at the number of insect traps, using the light at different wave lengths to trap insects -- a light mounted over a barrel of water with an oil film. The insects would swarm around the light and fall into the barrel and die. And I've seen piles of insects around some of those lights that were three and four feet high. So it apparently was quite effective in attracting certain types of insects. So electricity was quite an important factor and still is in Japan. At that particular time, there was no standardization. For instance in the prefecture where Tokyo was located, they had power on one side of the prefecture that was 50 cycles per second, and power on the other side that was 60 cycles. During a power shortage one district couldn't draw on an other district for any help because they didn't have the same frequency. You had to be careful to see that you got the right type of motor

Bainer: to operate on 50 or 60 cycles; the main thing would be a difference in speed. Most of the voltage was 220.

Another interesting thing about their electricity was that they paid, not through a meter unless they had a motor operation, but by how many lights they had. And so they would have a light on a long extension cord and when they wanted to move from room to room they just moved the light with them. That way they kept their rates down. They turned the light on and it just stayed on. They felt that the bulbs lasted longer if they didn't turn them off and on.

Well anyway, when I got the report done, I turned it in at 8:00 in the morning of the day I was going to leave that evening. Around 5:00 that evening I had a telephone call from the office. I was packed and ready to shove off that night. I was told that a car would call for me and I was to go and discuss this report with General Harrison, who was one of MacArthur's right hand generals. It amazed me that this man had read the report. Afterall, I thought that they'd dump the report into a file for later study. General Harrison wanted to discuss certain features and wanted to commend me on the information I had gathered.

The last thing I did as far as the project was concerned was to meet with about 200 manufacturers in Tokyo. They called the meeting. They had an organization of manufacturers which had contact all over Japan. I talked to this group. Well, the real reason I was over there (it took me a little while to find out) was that MacArthur was concerned about the use of resources, steel, for example, in making these little tractors that wouldn't run, and he was trying in a diplomatic way to stop this waste of material. I was there so that he'd have someone to pass the buck to. I realized that I should discuss my findings with this group of manufacturers.

We had a big luncheon -- that was the only Japanese food I ate while I was there. They had lobster, and boy, it was really delicious. Well, I told these people what I'd found. I told them about the success of International Harvester, John Deere and others, and I made a suggestion "Until such time that you have service in the field that can keep these tractors running and reactivate the ones that are idle (there were at least ten thousand of these tractors spread around and none of them running) you shouldn't build anymore."

Dickman: How did they take that?

Bainer: They took it. This put the responsibility right back on them. I said, "The thing is, eventually the farmers aren't going to buy anymore anyway, because the word gets around that this machine isn't any good, it won't run. You can't afford that kind of operation." I sure would have liked to have followed up on that thing a few years later. In fact they said I probably would be invited back. But it wasn't long after that 'til they closed up the project.

They closed up the service from the National Resources Section. You see we had an agricultural department there to get Japan back on its feet. There wasn't any need for them staying any longer.

As I've said, the agriculture department of the National Resources Section was headed up by Professor W. H. Leonard from Colorado, and he brought in experts in livestock, crops, soils, agronomy and ag engineers. And one of the real bright boys was Dr. E. V. Staker from Nebraska. He was a soils expert. Professor Staker was to be there for two years. He was bringing his family over. Well anyway, we went down to the hotel for lunch. (The only place you could get lunch was where you were assigned.) Staker was going to night school and was learning Japanese. And each day he'd try to learn some new words. The girls that waited on table at the hotel were all graduates of the University of Tokyo. They were smart girls and they all spoke English. But they also spoke Japanese, of course. And he could kid around with them and he'd use different Japanese words.

He was a milk faddist, and the Foremost Dairy people had set up a plant in Japan to reconstitute powdered milk into liquid again, and they served this at the hotel. (The only time I ever used it was on breakfast food.) That week Staker had looked up the words for milk, and there are several words for milk in Japanese but he didn't go far enough in the definition. The waitress asked him what he was going to have to drink and he said "Chi-chi." And you could tell there was something wrong. The girl was very polite and she waited until she at least had gotten in back of him and --

Dickman: She started to giggle?

Bainer: She started to gigle and she passed the word around and all the girls in the kitchen were giggling. I knew that something was wrong, but I didn't sayaword. And this went on all week but he got a glass of milk each time. So on Saturday noon, one of the other fellows joined us who knew a lot more Japanese than Staker. The waitress asked Staker what he wanted to drink and

Bainer: as usual, he said, "Chi-chi." When the girl walked away from the table this guy said, "Staker, do you know what you ordered?" Staker said, "Yes, I know what I ordered, and you'll see. I'll get a glass of milk." "Well," the other man said, "there's no question you ordered milk, but you ordered breast milk." Oh boy! [Laughter]

There was another instance that I thought was comical. I'd been at Nagoya and I was to leave on the noon train for Tokyo. When I got to the station I started looking around for the men's rest room. I asked the little red cap, "Where's the men's toilet?" He smiled and bowed, but nothing much happend. [Laughter] I said, "The men's latrine?" "Oh, train come in on track four." [Laughter] That's all the English he knew. But when I said, "Where is the benjo?" he took me down there and laughed. So, you had to know a few words of Japanese.

Dickman: Were you ever invited into a Japanese home?

Bainer: Only the Japanese homes in which the Allies were living. I never was in a Japanese home occupied by Japanese.

Dickman: Why didn't you eat any Japanese food?

Bainer: It was off-limits. We were told not to, and it was primarily because there were dangers of picking up something that might give us trouble. We couldn't drink any water except at headquarters where it had been chlorinated.

Dickman: And milk wasn't pasteurized?

Bainer: No, and of course, I didn't drink any locally produced milk. I carried rations with me in case of being caught out someplace. I was always issued rations and I carried cans of malted milk. I got awful thirsty sometimes but you just didn't dare drink any water.

Dickman: Did you detect any bitterness at all?

Bainer: No, it was just the opposite. I couldn't have been in Japan at a more opportune time. It was something like being in England during and right after the war. They were most appreciative of Americans. And the Japanese were just good losers. They just buckled right down and got to work and obeyed all the rules and regulations, and even as a civilian, I'd go down the street in a village and the police would even salute me. I had many Japanese young people stop me on the street and try to talk to me in English. They didn't have the pronunciation that I could

Bainer: understand. And then they'd pull out a pencil and pad and write. And they all wanted to be friendly. And I never experienced any thefts. For instance, I left some occupation currency in the pants pocket that went to the laundry, and it was delivered back and as soon as I got in my room there was a knock on the door and a girl came in holding out this currency bill. She grabbed the pocket of my pants to indicate she had found it there.

CASE HISTORY: UNIVERSITY-INDUSTRY COOPERATION: California Committee on the Relationship of Electricity to Agriculture: CREA

Dickman: Professor Walker, I know, was for many, many years chairman of CREA and you succeeded him in that chairmanship. You were chairman for how long?

Bainer: Oh, I was chairman for about fifteen years I think. Maybe longer. I remained chairman even after I retired from the University. I just dropped out of the chairmanship last fall.

Dickman: What is CREA?

Bainer: Well, the first C -- we don't usually use it, but CCREA would be California Committee on the Relationship of Electricity to Agriculture. And this is an organization that dates back to 1924. In 1923-24, or therabouts, there was a national move to set up committees on the relationship of electricity to agriculture at various land grant institutions, and tie in the agriculture research experiment stations, engineering, the farm bureau, or farmer organizations, the agricultural press, and the electrical manufacturers of electrical motors and the like, and the power companies. So they set up these committees in various states; California had a very strong committee starting in 1924.

Actually the money that this committee operated on was donated by the power companies in the state on a pro rata basis depending I suppose on the number of customers, or whatever the kilowatt factor was. And this has been a rather significant contribution all these years since 1924. It's been sufficient that the University could hire one or two engineers and pay them entirely from those funds and at the same time support research. While it was all directed to ag engineering, it was more or less earmarked for projects that would build load on the power lines. The philosophy has changed entirely in recent years, and they support work related to agriculture, but not necessarily with the idea of building more load on the power lines, their philosophy being that anything done to help the farmer is going to help their business.

And rural electricity in California is, of course, a very significant factor in the total power load of the state. I was in Kansas at the time that their CREA was set up, and Professor Walker was the man who organized CREA at Kansas State University

Bainer: at Manhattan. And as a student and as a member of his staff I worked on some of his CREA projects before I came here. The Kansas CREA is still in existence. I don't know whether it's been an absolutely continuous operation but I still get reports from their annual meeting.

When I came to California I found out that the CREA was doing a lot more work here than we were doing in Kansas, and they had people in the University that weren't receiving any part of their salary from CREA, yet they also were spending research time on projects that could be designated CREA, and in many instances were receiving financial support for their project. And, it wasn't only in ag engineering that this took place. Poultry used CREA funds to do work on lighting of birds to change their laying habits, or get eggs during the period that you normally don't get them. I think they soon found out that they didn't get an increase in total number of eggs per year, but you might shift the time in which the birds laid and get higher prices.

Oh, there were a number of projects. CREA supported projects at Berkeley. One of the professors there wanted to do some research on air conditioning in the farm home, improvement of living standards in the farm home. The initial work on hydroponics was supported by CREA. And people at Berkeley were working on electric insect traps in entomology, work in the use of light to attract insects.

Dickman: Like the ones in Japan?

Bainer: Yes, like the ones in Japan. The University actually sponsored an improved contract between farmers and deep well pump manufacturers on a marketing agreement. So, there were several facets of this thing. In recent years they've supported work in cubing of hay even though it's done out in the field and there's no electricity involved whatever.

Dickman: Why would they do that?

Bainer: Because it might improve the situation for the farmer. In other words, he might make more money and if he did he might buy more power. And, of course, some of this cubing was done in stationary plants which would be electrically operated. Well anyway, I think the first statement that I heard in 1929 when I came here, by Dean Hutchison , who was quite sympathetic to the CREA program, was that California farmers at that particular time used one and a third times as much electricity on their farms as all of the other farmers in the rest of the United States. And this is hard to believe until you began to analyze what was happening.

Bainer: And, of course, we had a tremendous pumping load in California; pumping the water for irrigation, and had an ideal set up to develop rural electrification because of the power generation in hydro-electric plants on the east side of the state in the Sierras, and the big cities on the west side. This meant that the power lines had to cross the valley at various points. So you had a tremendous power system already installed, and when you began to branch off of that and take care of the loads in the farming areas, it got to be big business.

Dickman: In other words, the very act of bringing water, say from Owens Valley to Los Angeles, did that work out so that power was created in the process of bringing that water?

Bainer: No, not on that one. Like development of power on Pitt River, for instance; there were three stages of power development on the Pitt River. I think there are three power plants. Same thing on the Feather River; they're generating power, you know, all the way down the Feather River. Rather recently, within the last ten years -- they completed the development of power on the Kings River, and I was fortunate enough to be invited to go up and see this. Well, there are three power plants on the Kings River, where they use the water three times. And the total head on those three power plants is 7200 feet, and that's a lot of head on a system. And I know at the last stage it took a penstock with a wall one inch thick to withstand the pressure.

Well, anyway, you had the generation of power in one location of the state and the big market was on the other side, and so you had transmission lines across the valley.

Well, CREA over the years has contributed, I would say off hand, a half million dollars to the University of California for research purposes. And, as I say now, with very few strings attached. We have to have approval of all the projects. The committee meets with the research people twice a year, and the committee is made up of research people on the station and people from industry, the power companies, and farm bureau. And they're very loyal, very faithful people. We've had all kinds of projects. We've had projects on poultry involving incubation, brooding of chicks, and processing. We've had projects involved in cooling of fruit; pre-cooling of railroad cars in which you're going to pack fruit to go East; pre-cool this fruit so that you start with it brought down to a certain temperature rather than reaching that temperature halfway to market. Actually pre-cooling before it ever left.

Bainer: We had work done on developing and processing hay in different forms. We did work on lighting of poultry and lighting of big beef feeding layouts. We have that going on right now to encourage the animals to eat more, over a twenty four hour period. When it gets dark, rather than laying down, the cattle may be inclined to get up and go eat some more.

We did work with pig brooders. I thought that was really out on cloud nine, in a way, to fix up a little retreat for the pigs to go where it was warm and they could get away from the sow and prevent her from rolling over on them; that was fantastic. They're used everyplace. We all laughed about it at the time it was suggested but it went over. A lot of work has been done on wine making. Jack Coffelt built a continuous press, a counter flow pulp washer, a color extractor and a spiral screen separator for taking the juice away from the pulp in an efficient manner.

Dickman: And this was all paid for by CREA and not by the farmers?

Bainer: Yes. It was an interesting thing. The wine people asked us to work on the mechanization of wine making. The request came to Dean Briggs who called Maynard Amerine and me in. Amerine was then head of enology and viticulture, and I was head of ag engineering. He told about this request from the wine group, but there wasn't any money, and it came too late to make a lot of plans. The vintage season was already on. After we talked about this problem, Amerine suggested that he and I just make a quick trip down through the wine country starting down at Madera and then up the San Joaquin and over to Napa Valley. (You know, I had been in California all these years and I never had been in a winery when it was in operation.)

Well, it was a very interesting experience and we had a lot of questions to be answered. One of them was, "If you just had the clear juice could you make good wine out of it?" And always the answer was "Yes." I said, "Well, I thought there were secrets of this trade." We were told that the secret depended upon culture and where the wine grapes are grown.

After making the study it was very evident that there was need for improvement in wine-making. There were some antiquated methods in use: batch processes of squeezing and removing the juice. And there was a great need to improve materials handling. After the wine was drained out of the vat you had all the pulp left that had to be removed. So there was a big material handling problem. And then, of course you had this problem coming up with drosophila (vinegar fly) which means

Bainer: you had to maintain cleanliness around the wineries.

Well, to make a long story short, the next time we had a meeting with CREA we went before them with a project with enology on wine making. They thought that was one of the greatest opportunities they'd had for a long, long time. So they financed the project from beginning to end. When it began to show some results, they didn't want anybody else to contribute anything because they wanted full credit for doing the work.

Dickman: I'm not clear on one thing. You said the total from CREA over these thirty years has been five hundred thousand dollars?

Bainer: That's right.

Dickman: That would be $25,000 a year?

Bainer: That's right. That's about what it was.

Dickman: And you could do all of this for that small money?

Bainer: Oh, if you do it over a long period. It'll be fifty years in two years from now.

Dickman: Fifty years; it would be only $10,000 a year then.

Bainer: Well, it's more than that because our budget has run between $20,000 and $40,000 a year. But we didn't get that much money because in the early years salaries weren't that high. We were only paying a fellow a couple of hundred dollars a month to work on a project. $2400 a year. So, I think it's over a half a million, but you're right. It isn't too much. But if you have $30,000 coming in every year, why you can carry a man or two.

Dickman: And Davis got the bulk of that?

Bainer: Yes, we handled it all at Davis but we did appropriate -- for instance A. M. Kofranek is doing work in the lighting of flowers to control the bloom. They're doing this commercially now.

Another very important aspect of this has been the support of an educational program through 4-H. They now have a four year course in electricity that is presented to the 4-H youngsters through extension. I mean this is a regular four year course for kids, that starts out with say, how to build a little simple motor, up to a public address system, that they can get the parts for and maybe for fifteen or twenty dollars and build the whole thing. And they had the farm advisors plus the rural

Bainer: power advisors from the power companies, you see, who had volunteered their services. We'd bring the leaders in here, or to Riverside, for instruction in these projects, and then they'd go back and meet with these kids and ride herd on them, and boy, I'll tell you this rural electric project in 4-H was the most important project they had.

We had another one in tractors that was supported by some of the oil companies, but it never did amount to anything compared with the kids making their own electrical apparatus.

Dickman: So would you say, then, that the relationship between the power companies and the University through CREA is rather unique?

Bainer: Oh yes, it's the longest of any existing, I'm sure, of any they've ever had with one industry.

Dickman: How often did you meet, this committee?

Bainer: Two times a year.

Dickman: And who's chairman now?

Bainer: John Goss.

Dickman: Have there been any objections to it?

Bainer: No, sir. It's interesting that there hasn't been somebody say we haven't any business getting mixed up with the power trusts. Well, they're not power trusts. These are publicly owned utilities. They're highly regulated.

Dickman: You haven't been involved on any research on atomic waste or anything?

Bainer: Oh, no. That isn't in our bailiwick, thank goodness! [Laughter]

WARTIME (WWII) RESEARCH:

Bale Loader

Bainer: During World War II there was a distinct shortage of man power on farms, and the work had to be taken up by younger or older people. And many older people weren't able physically to do the jobs that were normally done by younger, more able bodied men. One of these problems was the loading of baled hay onto trucks in the field. These bales -- the smallest one would weigh maybe eighty pounds, and the large ones would weigh maybe 150 pounds--required great effort to get them off the ground and onto a truck. And this was done by hand. It was amazing how much hand work was involved in loading hay.

So, J. S. Winters who was one of our non-degree instructors that I mentioned earlier and J. P. Fairbank of extension decided to build a simple bale loader. It was built on a chassis from an automobile rear axle including the wheels and the differential. Power from the wheels drove the elevating mechanism. It was adjustable as to height, so that you could drive down the row where the bales had been deposited by a baler and elevate them onto the truck.

I don't understand why we had to wait for a war to build a device like that, but it was the pressure, you see, of how are we going to get this hay out of the fields. So Winters and Fairbank put on a barn storming trip through the hay producing areas in California -- and they issued plans on how to build loaders. They would go in and attach this device to the farmer's truck and let him pick up hay while a neighbor saw it. And then they'd discuss how these things were made. Maybe the shop men were brought over or some blacksmith in the area. There were a lot of these built locally using old automobile rear-ends.

Dickman: The farmer could do it himself?

Bainer: Yes, and the local shop. But when this thing started to succeed, many local manufacturers saw it. It was a real hot item! And even Blackwelder and International Harvester started making them. Of course no one loads hay by hand now. But it was a real godsend during the war when you didn't have the labor.

Tree Shakers

Bainer: Another interesting development that came about during the war was tree shakers. Fairbank, our extension engineer con-

Bainer: ceived the idea of attaching a cable to a tree with a hook. The cable was tightened by backing the tractor, to which it was attached, away from the tree. At the tractor end, the cable was attached to an eccentric that would move back and forth. As the oscillating motion was transmitted through the cable, the tree would shake. Frameworks under the trees directed the flow of the fruit to boxes. The initial work was done on prunes.

Well, this led into a long series of developments in tree harvesting equipment, but it all originated here with Fairbank and Al Rizzi,extension pomologist. When they got into walnuts, several problems developed. One was when you back to put tension on the cable, sometimes the guy didn't stop soon enough and he'd pull a limb off the tree. And this was disastrous. The other thing was that you had to get up in the tree to put the hook on it. So, it wasn't long before the rigid boom shaker came. Well, the boom shaker acted almost like the cable except that the boom shaker had a tree clamp that you could control from the tractor seat. The boom was attached to an eccentric on the front of the tractor. Its position could be controlled from the tractor seat. It was just simply an evolution from the cable to a stiff member with a remote control hook that you could attach on the tree.

Dickman: What's the difference between an impact and inertia shaker?

Bainer: Well, an impact: you just simply hit the tree and depend on the vibration, set up with an impact, to shake it. And the inertia shaker was the one that just put energy in the tree in two directions.

The prune growers went to the Congress of the United States and got an appropriation for doing research toward mechanization of prune harvest. And, the first thing we knew the growers said, "We've got this money, and we want to turn it over to the University." Well, that made it possible for us then to go out and hire Robert Fridley. And at the same time the USDA entered this in a cooperative way, by hiring a man by the name of Paul Adrian. So these two men started working on this project, and they started first with prunes. They came up with twin portable catching frames. They were self-propelled. One was used on each side of the tree row. When they were centered on a tree they could close the gap between the two catching frames so the fruit wouldn't be lost between them. An inertia type shaker was mounted on one of these frames. One man could then take hold and control the position of this boom and make the attachment on the limb. The inertia shaker exerted all of the forces

Bainer: parallel with the boom. As the fruit came down it was caught on the catching frames. They had an area of about seven feet by twelve feet. And they had a canvas draper on the surfaces that would run and collect the fruit and drop it into a four by four foot bin at the end -- a big bulk bin.

Dickman: Is this where they used that rubber beach ball placed in the fork of the tree?

Bainer: That was just an idea that never developed into more than something to play with. But it was a good idea. Anyway, coming back to this inertia shaker: I mentioned the work that John Powers did in vibrating the knife on the sugar beet harvester. Here's where you take an idea that was for an absolute different purpose entirely. And when they wanted to build a vibrating device to remove the fruit from the tree, I suggested to Adrian and Fridley that Powers had built this little inertia drive that vibrated a knife. And while the length of the stroke on the knife wasn't as long as they would need on the tree shaker, the idea was there. The idea of this inertia device was: there were two gears that ran in mesh. These gears were eccentrically loaded. In other words, half of the gear had a weight. The centrifugal force set up by these revolving weights added fore and aft and cancelled out at right angles so you could control the direction of the shake.

Well, they found the little device that Powers had made and actually hooked it on a limb and found that they could shake the limb with it. The next thing was to rig up something practical to attach to the stiff boom. They used to call the inertia mechanism the little black box, and few knew what was in the little black box for a long time.

I observed the prune harvest several times. They had two porable catching frames one on each side of the tree row, each controlled by a man. These were self-propelled units. You had to guide them. You didn't have to turn them around. You could run them forwards and in reverse. And they had a draper that collected the fruit. They had sideboards on the catching frame, and then they had the four by four by four bins which held a half a ton of fruit. And when they were full they had a lever they could drop the bin on the ground and pull out from under it and put an empty on it and continue.

So there were three men, one on each frame and one to control the shaker. Most of the orchardists by this time had pruned their trees so that they only had, say, three main scaffold branches. You only had to make three attachments on the tree

Bainer: to shake it. These three people could harvest a tree a minute. And when you saw them doing fifty to sixty trees an hour you wondered why anyone ever picked a prune again. It's just ridiculous when you see how easily the work can be made.

Well, that same idea, of course has gone into peaches and apricots. They've never been able to harvest pears yet. There's too much bruising of the fruit because of spurs on the tree branches. We haven't been able to harvest citrus, but peaches are coming along pretty well and apricots probably will, but the apricots don't ripen up uniformly enough. It's a matter of genetics, I suppose to get apricots that will ripen uniformly. Mechanically shaking a peach tree and getting the fruit down required the installation of decelerating strips above the catching frame to absorb the energy of the falling fruit. Otherwise the fruit will be bruised when it hits something solid or hits another fruit. And this was a rather simple device. They simply put in a maze of strips of canvas above the conveyor table. The strips were about two inches wide with a little space between them, and then there would be another set of strips below that were half out of phase with the top set, so the fruit would hit and kind of wiggle through. The energy of the fruit was absorbed before dropping on the conveyor.

The pruning of the trees has been a big factor. I can remember some of the very, very early work that was done. The boys who were working on mechanical harvest called a meeting of their research committee which was made up of ag engineers and pomologists. I can remember going to one of those meetings when they began talking about preparing the tree for mechanical harvest. Some of the older generation of pomologists found the idea hard for them to accept. And yet, some of the younger pomologists said we are going to have to do this or we aren't going to grow peaches. They could see the handwriting on the wall.

Dickman: Is the tendency now to grow peach trees, say, like a big hedge?

Bainer: No, not with peaches so much as some of the others. Now citrus and pears have been tried out in the hedge form. Harvesting is done by hand from a platform with variable heights where people could work at various levels. I saw some of these hedge plantings down in Florida. They looked encouraging to me.

POST WORLD WAR II RESEARCH:

STATUS OF THE MECHANIZATION OF VARIOUS CROPS:

Sugar Beet Finale

Bainer: By 1948, we had been working on sugar beet machinery for ten years and had put a lot of man years into this project. By that time several commercial concerns were building sugar beet machinery and the sugar company engineers were working on the problem. In the early years, there was only one man -- Mervine, working on the project. During the ten year period we probably had a total of eight people working on the project. We figured by 1948 there might be two hundred people working on sugar beet mechanization. Professor Walker felt that we had reached a point where we could bow out of this program. I know I disagreed with him some at the time, but it was very evident that we weren't as important in this program now as we had been originally, and we had stimulated a tremendous amount of activity and had made definite contributions. So we bowed out in 1948.

Now there have been other projects related to the sugar beets, such as the synchronous thinner that I mentioned, that were developed years after that period. And some of the continuous spray treating of seed that Kepner developed, which I haven't even mentioned, was certainly related somewhat to sugar beets.

Harvesting a Variety of Crops

Bainer: But when we bowed out in 1948 we had a long session of the staff in agricultural engineering, to look into the future. It was evident that field crops were pretty well mechanized. Certainly the rice and small grain harvest; sugar beets were coming along, hay harvest certainly was mechanized. This, of course was before the pelleting and wafering of hay. Cotton machinery was beginning to show some promise. So that in general, it looked like the field crops were pretty well mechanized. If the ag engineer was going to continue to contribute to California agriculture, he was going to have to look at the other crops which hadn't been touched to any extent. They consisted of the tree, vine and vegetable crops. And then it was a matter of which crops do you attack first?

Bainer: Well in the tree crops we'd already had a little experience as I mentioned, during the war, of shaking prune and walnut trees. So this seemed to be one of the logical areas to work in. And looking to other deciduous fruit; peaches offered an opportunity. Apricots -- it appeared that they could be mechanized, but we found later that there was quite a variation in the degree of ripeness throughout an individual tree so that it would be almost necessary to go back over the tree a second time.

Pears were so easily damaged that we still haven't done anything significant in the harvesting of pears except the aid of a platform that moves through the orchard with the pickers positioned at different heights so that they can reach into the tree and pick pears with a provision for collecting pears on the platform.

Dickman: Has there been a lot of work done in fruits? Cherries and melons for example?

Bainer: Oh yes, the cherry harvest is akin to the peach harvest and to the prune harvest, I mean the same type of equipment is used for bringing down cherries. I understand there are some chemical sprays that have been tried on cherries to loosen them so that they would come off -- that is loosen the stem from the fruit so that when you're harvesting the fruit would come off the stems. In other words, if you're going into processing certain types of cherries you don't want the stems, you'd like to have them free of the stems. And, of course, there are stemmers that are available for pulling stems off of fruit like that. But Michigan probably led the pack in cherry harvest for a while. Now we're doing some work like this in California, and they're using chilled water to transport the cherries from the orchard to the processor in order to maintain quality. But it's by a shaking of the tree process, and there's still some problems there that have to be overcome.

Now, we come into other fruits. We had a request from a group of growers in San Benito County, where they produce apricots -- a lot of apricots -- and these apricots are cut and dried on trays in the field -- sun dried. These apricots are all cut by hand. It was getting to be an expensive process, and so the growers came in and wanted to know if we'd be interested in developing a mechanical apricot cutter. Lorenzen took on the problem, and one of the things that was necessary was to cut these apricots on the suture. There's what appears to be two halves of an apricot, with a ridge running around them which we call a suture. And they'd like to have that apricot cut on the suture. Lorenzen found out that he could orient the apricots

Bainer: to put the sutures in a horizontal plane by passing the fruit over air or water jets. In his prototype machine apricots were fed one at a time onto a belt with cups in them. The water was introduced on the underside and moved up around the apricots that were resting in these cups. It was a kind of a pulsating action in which the apricot was lifted and dropped, lifted and dropped -- just kind of vibrated along, but every time you lifted it there was turning, and all the apricots lined up with their sutures horizontal. Then he devised a cutting mechanism which started at the front of the apricot and cut right around the seed. The seeds were forced out leaving the two halves. Then he had the problem of placing these two halves on the tray with the cup side up. He did this in a very clever manner using a series incline troughs made up of V-shaped aluminum. The V had a 60 degree angle. He used a belt to convey the fruit across this V-troughed incline. Periodically, just as the fruit would cover the whole width of this trough, which let's say was three feet side, there would be a reel to sweep all the fruit off of the belt and let it fall into the troughs. And the trough, then, would receive this fruit and was vibrated and the fruit would roll down on its edge. When it came out the lower side, the center of gravity of the fruit was in the bulge, and they'd just lay right out with the cups up. When they came off of the trough -- it was really uncanny, and it took very little placement then to line them up and put them through the sulfur house and out on the drying trays. Well, here was a machine that was very ingenious and workable. And here was a group of growers that asked us to do it. Do you think it ever went any further? It was a funny thing. They had two or three meetings with Blackwelder, and Blackwelder agreed to build this machine. But it just didn't go any further. And here we were with a good idea and a satisfactory solution, but it was the end of the line.

Dickman: Maybe the day will still come.

Bainer: Yes, it's available. It's like a lot of other things. If we really get up against it, it's available.

Dickman: What are they doing on mechanical harvesting of nuts?

Bainer: Well, it's all done by tree shaking now. Walnuts and almonds, mainly -- those are the two main nut crops. The walnut trees are getting pretty large and they use a rigid boom type shaker that can go up and grab on to a branch and give it a shake. With some catching frames or some method of collection, the walnuts and almonds are pretty well mechanized.

Dickman: There wasn't soil compaction trouble there?

Bainer: No, because before harvesting you discontinue the irrigation and end up with a dry field. Oh sure, there'd be some compaction but as the soil dried it compacts less. One of the things that did happen in the early days of prune and walnut harvesting was the development of a small unit for picking these up off of the ground. This I still think has some importance because winds at harvest time -- you might have fifteen percent of your fruit down on the ground -- and that's pretty expensive to pick them up.

The practice that was followed when we entered this picture was of floating and rolling the orchard, make a very smooth -- as hard a surface as you could with the soil and the condition it was in. Fridley and Adrian worked on a pick-up device. They came up with a small revolving rod that worked practically at ground level. It was small enough to be below the center of gravity of prunes, for example, and this lifted the prune or the walnut, just enough to catch them between the rod and a larger rubber covered roller, and flip them onto a conveyor and into a box. There were several people who built these machines commercially. The first were hand operated. You had a little engine to run the rollers to flip these prunes off the ground, but you guided it by hand and you walked behind it. Then of course it wasn't long 'til people wanted to ride. The next thing we knew they were enlarged and made as a self-propelled unit that the man rode. And there were some fairly elaborate machines developed for picking up off the ground.

Well, now, there's little of this done because they get in there and shake the prunes or walnuts on to the catching frames. But there are pickups that just work beautifully with fruit that's laying on a smooth surface.

Dickman: Is this also true of olives?

Bainer: No, olives are a different problem entirely. Olives in the first place are held tight and it takes quite a little force to pull them off. And second, the branches on olive trees are very, very long and willowy -- not like the short spurs that prunes develop on. Olives just wave in the wind, you know, because they're hanging on to a rather willowy limb.

Well, you put a shaker on an olive tree and shake it. Due to the willowiness of the branch, you just can't get the energy into the fruit -- it's all damped out before it ever gets to it. As a result the fruit just shakes with the tree. Well, they've run longer strokes, and different frequencies, and now they have shakers that will bring down seventy-five to eighty percent

Bainer: of the fruit, but it's very difficult to get it all. Maybe some pruning will help, I don't know. I was in Spain just last December, and visited the olive country in Southern Spain, and ran into one area around Jaen that had a million acres of olives. Everyplace you looked the hills were covered with olives. They prune their trees rather severely because of limited moisture. Under Spanish conditions (and I'm going to have an opportunity to find this out because I'm still involved) they can shake the olives off because they just don't tolerate long willowy branches. These olives are much closer to the main scaffold branches. They're interested in mechanical harvesting. I suppose we're going to handle olives mechanically in California. I think we can get maybe ninety percent of them. But, I don't think we are going to get the high percent we get in prunes, for example.

Dickman: What about melons?

Bainer: Here's a problem that Michael O'Brian worked on. He used the principle of a cucumber harvester that was developed at Michigan State. In the first place he determined early that he was going to have to make a selective harvest. Now he's satisfied that maybe the plant breeders might give him a plant where the fruit ripen up more uniformally and make it a once over harvest. But he started out on the basis that it was going to be a selective harvest. He was going to have to make multiple pickings, and so he had to prepare the field for selective harvest, which meant that he wanted all of the plants on one side of the row. So he built a trainer with rubber fingers. As the plants developed went down the row with the trainer with the rubber fingers and raked all of the plants so they were on one side of the row. And this worked out pretty well.

Then the idea was that he would pick the vines up and the machine would move ahead as fast as the conveyor moved back so there would be no relative motion between the vine and the machine. The vines were brought up over a belt type conveyor which was vibrated. When a melon approaches ripeness, an abscission layer developes between the melon and the stem, and after a while it separates. But, at the time of harvest when these melons were approaching ripeness, the abscission layer weakens. And so with regulated vibration, he could shake off melons which were approaching ripeness because of the weakness of the layer. And then he carefully laid the vine back on the ground and continued on down the row. And then a few days later he came through and picked some more.

Well, I thought this was a world beater. I ate melons harvested by this machine over a period, and I never had a bum

Bainer: melon, because this machine couldn't take one off unless it was ready to come off. When a hand crew goes through the field, they reach down and get a melon of marketable size. They're not going to let go of that melon even though they have to really tug at an immature melon to pull it off. Possibly, for long shipments, we'd have to take melons off before they're completely ripe.

Well anyway, I understand that the plant breeders now are working on a determinant type of melon that will ripen over a shorter period.

Another development that we had little to do with was a cucumber harvester. This was a development solely by Blackwelder. They call it a pickle harvester. Actually they're cucumbers until they go through a pickling process. It is destructive as far as the vines are concerned. They cut the vines and remove the cucumbers and put the vines back on the ground. Well, this is going to really have an influence on where cucumbers are grown for pickles. In the first place, the harvest must be done at exactly the right time. You don't have a leeway of more than a day or so. This means that you have to have perfect weather, and we have it in the growing season in the Central Valley.

Furthermore, you can get two crops of cucumber a year, and the yields are two or three times the national average. So what's actually happening now with the development of that cucumber harvester is attracting the industry to move to California.

The machine saves all sizes of cucumbers. The small ones (little finger size) are worth $80 per ton as compared to $20 a ton for the larger ones. It's always been difficult to get hand pickers to harvest the small ones. So here's a situation that Blackwelder worked on his own to develop a harvester. He has a lot of confidence so he goes ahead by himself without any help. We were just observers. So, this was wonderful. We don't regret this at all. After all, anybody that solves a problem in California tickles us, whether we have any hand in it or not.

Dickman: What other crops are there that are difficult to mechanize?

Bainer: Strawberries are the first that come to my mind. I'm not saying that they can't be harvested, because there are people working on strawberry harvesting. I think it's pretty destructive to the plant. Maybe the geneticist is going to have to develop a strawberry that ripens pretty uniformly. The units that have been developed are strippers. They have a

Bainer: stripping action and strip off the ripe berries. It looks like we're going to have a little tedium in picking strawberries for a while because they're easily damaged. They're a soft fruit. We're now hoping to ship berries greater distances. There's a tremendous amount of berries shipped by airfreight clear across the country. And they have to be in pretty good physical condition in order to make the trip and that means careful handling. Maybe for canning and the like, the mechanical harvesting will come in. But right now the outlook isn't too bright.

Dickman: How about sweet potatoes?

Bainer: Well, sweet potatoes are also easily damaged. There's at least three or four experiment stations in the country — Maryland is one and I think North Carolina is another—that are working toward mechanical harvesters, but there'll still be some hand selection in handling grading and hand placement, I suppose in the bin. Michael O'Brien and a farm advisor conducted a test in California in which they harvested with a machine that we call a potato combine. In these trials, sweet potatoes were lifted off the belt by hand by five or six people riding on platforms on each side of the conveyor. They put them into four foot cube bins. The behavior of the potatoes in large bins was compared with those in a standard 40 pound lug box. They found no difference in the amount of storage loss whether they were in the 40 pound bins or in the big bins, and it took less total storage space to store the potatoes in the big bins than the small ones.

Well I feel that mechanical aids at least are going to come into the picture to take away a lot of the stoop labor that is used to pick up sweet potatoes. One of the big problems with sweet potatoes is the root development which is entirely different from the Irish potato. The roots are kind of enlarged where there's a potato. You've got a mass of roots running through quite an area with a wider distribution of sweet potatoes than Irish potatoes, so that the problem is separating potatoes from the root system and the dirt. If they go into starch or processing, a little bruising isn't so important. But when you go into the fresh market they almost have to be handled with kid gloves.

Citrus

Dickman: What about citrus?

Bainer: Citrus has been a very difficult problem to work on. There's still a lot of work going on in citrus. Most of this is being done at Riverside.

Dickman: Under Davis Ag engineering?

Bainer: Yes. The department of agricultural engineering on the Riverside campus is a part of agricultural engineering at Davis. This department was set up primarily to work on the harvesting of citrus crops. While we had done a lot of work at Riverside, from Davis, in orchard heater work and frost protection. When we really got into the problem of working on mechanization of harvesting of citrus and handling of citrus, it seemed to be desirable to station people at Riverside. Professor Russell L. Perry, who came to Davis in 1928, was transferred to Riverside, and he holds the title of vice-chairman in agricultural engineering with responsibilities at Riverside. His staff has been augmented a little. There have been USDA people there, including Roger Perkins, who Perry hired when he was at the Los Angeles campus. You see, Perry had actually spent some time at UCLA before going to Riverside. And Perry was also involved in the UCLA-Indonesia educational program, and was in Indonesia for a couple of years.

Color Sorting

Bainer: When we closed out the sugar beet program in 1948, we had had a request from a group of lemon growers in the Ventura area for some help in color sorting lemons. I might say that lemons are picked every month in the year. The heaviest pickings come in the winter months and the heaviest demand is in the summer. And when they're picked they have four distinct shades of color -- yellow, silver, a light green, and dark green. The yellow lemons have to be either marketed or go to processing as they're picked. They can't store them for any length of time. The silvers can be held for a few weeks. The light greens can be held for three months, and the dark greens can be held for six months. All that's necessary to ripen this fruit is to give them an ethylene gas treatment which brings out the yellow color. Actually, they have educated the public to the yellow lemon as being the ripe lemon when actually the green lemon is just as useful and can be used just the same as a yellow one except that the public doesn't think it's ripe.

The harvested fruit is taken to the packing house where women sort it according to color in the four classifications. And

Bainer: this is expensive, and inaccurate. They didn't realize the inaccuracy of this job until we actually got some electronic color sorting equipment in there. And further more the women have to have rest periods because they're using their eyes in doing this color sorting.

Albert Thille who was one of the key men in the Ventura section was a great friend of the University and a great friend of H. B. Walker and Knowles Ryerson who was the director here at that time. He kept pestering Walker and Ryerson for someone to work on this problem. So Professor Walker talked with John Powers. John Powers, as you'll recall, came through the electronic route in college and had been in radio before we hired him. He had done a very good job on the sugar beet program which was entirely foreign to electronics. So Walker talked with Powers who didn't know of any existing color sorting equipment, but he felt that it was worth an effort. He wasn't sure that it could be done. To start with they shipped lemons up from Ventura in these four color classifications. They had been separated by hand. We didn't have a continuous recording spectrophotometer on the Davis campus. Powers wanted to put these fruits through the complete spectrum. He wanted to see what he could pick up from the fruit. Well, there was a spectrophotometer at the Albany lab which is operated by USDA. The Regional Lab, they call it. He made a deal to put fruit through this spectrophotometer and pick up reflections at the different wave lengths of light. He started out by shining violet, indigo, blue, right down through to red light on the fruit. The percentage of reflection was plotted against the wave length of light. There was no practical difference in reflections until he approached the red region. Then there was a sudden dip in reflections which were related to the color. The yellow lemon reflected about seventy-five percent of that light, the silver fifty percent, the light green twenty-five percent, and the dark green ten percent.

Dickman: At the same wave length?

Bainer: Yes, at the same wave length. He established, then, a family of curves with a range of seven and a half to one. In other words the yellow ripe fruit reflected seven and a half times as much light in the red region as the dark green. Then there was a recovery on all the curves. In other words, they made this dip and then came back out at shorter wave lengths. Well, this gave him a clue. Here was a separation of reflections at a certain wave length of light. So he then developed an experimental device which would shine this wave length of light alternately with the wave length in the recovery region.

Bainer: And then -- he used a light source and a prism which split this light up into the seven colors of the rainbow. This gave him a source of monochromatic light. The alternation was accomplished by means of a rotating scanning disc.

A series of holes in a disc in a wave pattern near the periphery gave the alternation between 6780 and 8000 angstrom units. The recovery from this dip was much steeper for the green fruit than it was for the ripe fruit. He then used two points on that curve and actually compared the steepness of the recovery for different reflections.

This gave him a signal and he amplified it about a half a million times, and that gave him enough energy then to operate gates. And so he had, then, a device that would separate these lemons into four color classifications. And it was instantaneous. You know, light travels about 186,000 miles a second. And so the readings were practically instantaneous.

He then had to develop a means of feeding the lemons in. Each lemon had to be separate from the others in the line. He had to get a reading on every lemon. The mechanics of this got to be a bigger problem than the electronics. He finally got up to 40 fruits per second, and that's six hundred field boxes an hour that they could put through the machine.

Well, it got to the point where it was ready for a run in a packing house. And in the meantime two other fellows within the department began working with Powers because he was going to take a Sabbatical and be away for a year. In order to keep this project going we interested Fred Jacob who was then in the department, a graduate electrical engineer with a master's in ag engineering, and another young fellow named Jack Gunn. We put Powers, Jacob and Gunn working on this thing together, but Powers was the real brain behind it. So they took the unit to Ventura and got it set up. Of course it didn't have the capacity to take care of the whole line, this was just a prototype. When the machine was set up they asked the packing house manager for some fruit to run through it. Well, you know, when you take a machine into a place sometimes there's a certain amount of resistance. It isn't really resistance. I don't know what it is. I don't know how to explain it.

Dickman: Fear of change, maybe.

Bainer: The packing house manager was going to play a joke on them, actually. This was a joke that backfired. So he went and got a box of fruit that had already been color sorted by hand, and

Bainer: was all light green. And when you looked at that box it looked like it was all light green fruit, and that's what the girls had put in the box. Well, they put this through the machine, and about half of that fruit came out in the light green category. A fourth of it came out in the dark green category, and another fourth came out in the silver. And when you got those three colors side by side, there was no question in the world. And talk about a joke backfiring on a group of people. I'm telling you! There were others in on this joke. This was going to be a ha-ha, you know. And when they saw these three colors in three different boxes, I'm telling you, they were really excited.

Dickman: Fifty percent accurate, by hand (or by eye.)

Bainer: It was terrible, it was really terrible. Well anyway, this development went along and finally reached the stage where it should go commercial. Food Machinery made a deal with V.P. Robert Underhill, Chairman of the University Patent Board, to manufacture it on a royalty basis. Well, Food Machinery worked on this thing for two or three years. And Powers worked with them -- we donated Powers' time. They finally built a machine that approached the capacity of the system. But do you know that thing bogged down and has never been used. And here was a method for doing almost a perfect job.

General Electric, when they heard about this work, sent a man here with the idea of furnishing components for the unit. He told us that Powers was further in color sorting of fruit than anyone else in the world.

Powers did get the John Scott award for his invention. It was an award that was administered by the city of Philadelphia. Apparently there was a Scotsman who was a great admirer of Benjamin Franklin. He donated money in his will to the city of Philadelphia to be used for a bronze medal to be awarded to the most ingenious inventor of the year. Well anyway, Powers' name came up as a contender for that award. I think Dean Boelter at UCLA entered him. Now, there had been others like Madame Currie who got this award, and Luis Alvarez at Berkeley who had invented the ground control approach for landing an aircraft.

Anyway, I started getting correspondence from the city of Philadelphia, and I answered it all to the very best of my ability, and we got letters from others. All the while I thought he's really associating here with pretty big company when you saw the list of the former recipients. But in the finals Powers got the award and a thousand bucks.

Bainer: What Powers had discovered was a chlorophyl response from the fruit. The chlorophyl is there all the time, but it is masked out as the fruit changes color. The chlorophyl isn't picked up from the ripe fruit, but it is for the dark green. The degree that it is picked up is the color responses that he used. Well anyway, it has a rather sad ending because this was really a magnificent job of research. There just wasn't anybody that had ever gone in this direction, and when the patent was applied for -- it's one of the few patents that the University ever got that didn't have a lot of conflicts with prior art.

Now, along this same line, Jacob and Sprock, our electronics technicians, and RR. Romani in pomology became interested in trying to determine the interior quality of a fruit without destroying it. The recent work along this line was done at Beltsville by a scientist in the Agriculture Research Service of the USDA by the name of Carl Norris. And Carl Norris had been bombarding fruit with a light and correlating the deflection of this light with the interior quality of the fruit.

Dickman: You say interior quality, what are you - ?

Bainer: Say brown rot, something that's in there that isn't visible from the surface. It might be granulation, it might be frost damage. There's a lot of things that could happen that wouldn't show up on the surface. The pomology department through Dr. Tufts approached us and wanted us to work with them on this determination of interior quality. So, they started to work on plums. They built a prototype machine which would just take one plum at a time, and they could put this plum in a black box and close it and bombard it from a light source and measure the deviation or the characteristics of the inside of this fruit. They had an X-Y plotter that automatically plotted the degree at which the light passed through this fruit. Well, they began having trouble right at the beginning. They'd set the X-Y plotter at a zero setting, and before they could start, the zero setting had changed. They reset it and zero changed again. It took quite a little while to reach equilibrium so that it then could do what they wanted to.

They knew something was coming from this fruit that was changing the zero, see, but they didn't have the time to investigate it. They had to get certain information from the plums when the plums were ready, and they had several boxes of plums to work on. They were sampling. They knew -- it eventually came to equilibrium, so they moved everything in to a dark room. And after the fruit was in this dark room for a few minutes, it

Bainer: all come to equilibrium and they went in and got all the information they wanted. This phase of the problem was all taken care of.

After they got the data from the plums, then being true scientists, they went back to find out what was coming from this fruit. So they started measuring the fluorescence that came from the fruit. This fluorescence was the chlorophyl response that old Mother Nature was sending out into the atmosphere and the only way you could stop it was to put the fruit into a dark chamber and hold it there for awhile and of course the energy was dissipated and the fluorescence stopped. Well, they measured this wavelength, and what do you think it was? It was 6780 angstrom units. And I tell you I was just as excited as I could be about this thing. I mean it really was exciting. It looked so practical. What can we do in a practical way? This all happened about the time we were developing the tomato harvester and here was a problem on the tomato harvester of throwing out the green fruit by hand. And so they developed a little prototype machine in which they could take green and red tomatoes on a belt into a tunnel out of the light (and it didn't have to be light-tight, just get it out of the light) and keeping it in that tunnel for just a matter of a few seconds, as it passed by a photo tube, an electric eye, and this eye would pick up the fluorescence. Well, the interesting thing was that the signal that they could get from a red tomato decayed in five seconds. But the signal from that green tomato could be detected for 20 minutes. So they ran this fruit in single file through the tunnel and past the electric eye. The electric eye did not detect the ripe fruit, it just went on by. But when the green fruit came by it detected the fluorescence, and again you had a very weak signal that had to be amplified to give enough energy to flip a gate. And here was the simplest color sorter where you had the extreme of red and green that you could possibly think of. They're still working on this idea as a possibility to put on a tomato harvester to sort out the green fruit.

Well to me, I thought this had another application, but I never got to first base with it even though I suggested it. Albert Thille was in my office. He was, of course, the promoter of the original color sorter for lemons. We began to talk about the lemon deal again. I was very much discouraged and unhappy that the first lemon sorter didn't go. I knew from past experience, and I verified this with Thille, that about half of the lemons that were produced in southern California went into process and the other half reached the fresh fruit market. So, I told Thille "here's the simplest possible color sorter you

Bainer: could ever have that will really detect dark green lemons. I suggested sorting out the dark green lemons as they were brought into the packing house. They could be stored for the fresh market during the following summer. The balance of the fruit would then go to market or processing immediately. I still think it was a good idea. I said, "Why not?" He said, "We're always in hopes that we'll be able to market more than half as fresh fruit." I suppose there is a fluctuation in the demand. But, to me, there was a world beater, fast and accurate, and as long as you just wanted to make one separation, dark versus the rest, here was a possibility.

This began to show that ag engineering was getting to be rather sophisticated when you began to get into this speed and accuracy which this color sorting had to accomplish. Well, it started a lot of other work that eventually came out like the plant thinner, e.g.

Dickman: I understand that there has been some mechanization of the harvesting of citrus but that the citrus people don't want it.

Bainer: Well, I should think they want it, but there are so many problems. Where you're picking fresh fruit such as fresh oranges, it's a little difficult to eliminate damage. Now in Florida, it's a little different picture because they are processing a high percentage of oranges and grapefruit. In lemons, of course, you've got lemons at different stages of ripeness and even blossoms on the tree at the same time. It's pretty hard to shake the ripe fruit off without destroying the smaller fruit.

Date Harvesting

Bainer: Dates are a little bit different. The date growers put the pressure on us to do some work on harvesting. The date palm is a peculiar tree in that it just continues to grow, and you can't cut it back like you can trim a deciduous fruit tree, so that you have to continue to climb the date palms in order not only to pollinate the dates, but also to pick them. And some of those date gardens now have trees that are sixty feet high. And about the only people that they could get to work on ladders at that elevation were Mexican nationals. And of course the date people had followed the practice of picking individual dates as they ripen. In other words, a man was up in the tree day after day, going over the bunches and picking the dates as they ripen. If you're going to mechanize, certainly one of the things that appeared to be necessary, was to be able to

Bainer: cut a whole frond of dates and bring them down at one time, depending on their ripening in storage.

Fridley and Adrian started working on the whole branch. Well, the first thing was to get a man into the tree. This was done from a platform on a hydraulic lift. Then they developed equipment so that when you cut the frond containing dates, they would lower it to the ground level in a basket on a pulley arrangement. They developed a shaker to which they could attach the frond, which would remove the dates from the branch. And then the dates were taken to the warehouse for sorting and processing. And this has worked.

VEGETABLE CROP HARVESTING

Bainer: Now, when it came to vegetable crops, what were we going to work on? Well, one of the logical ones was, of course, processing tomatoes. And so it was decided that we'd work on the mechanization of the tomato harvest. Other vegetable crops were asparagus and lettuce. We made the attack on tomatoes and asparagus almost simultaneously.

Onion Harvesting

Dickman: How about onions?

Bainer: Oh yes, onions also because of the tremendous amount of labor that's used in harvesting them. Coby Lorenzen actually developed an onion harvester that worked on the same principal as the Scott Viner machine which lifted the beets by the top. It lifted onions by their tops, and then topping was done by a pair of rotating discs in the machine. This was never really accepted. There have been some modifications of it and there's more interest in it again but that machine never went commercial.

Asparagus Harvesting

Bainer: Bob Kepner worked on asparagus harvesting. He analyzed the situation and according to his calculations, and I'm sure that it was the right approach, he felt that you couldn't afford a selective harvester. Asparagus comes up all over a bed three or four feet wide and normally it's cut by hand every day or

Bainer: so.

So Kepner worked on two methods; the first was cutting green asparagus. It seemed to us that the trend was toward green asparagus even though ninety percent of the white asparagus at that time was produced in California and canned. (And it practically came from one county.) Kepner worked with Jack Hanna in vegetable crops on asparagus. He felt that we were moving towards green asparagus. So the first machine that Kepner built cut everything above ground level. Of course you got a lot of waste because there were a lot of asparagus sprouts just coming through the ground and you had to have six or seven inches of asparagus to make it commercial. And it proved out that once you made your first cut, if you watched the growth and made another cut at the right time, say three or four days later, you would get a 70 or 80% of spears that were marketable.

He built a rather ingenious unit that covered the top of the beds. It had a band saw type of knife that cut just below the surface of the ground. He built a mechanism that had a series of spring loaded discs that were separated at the front to permit spears to go in between the discs and then the discs closed. The spear was held while the knife cut it. The spears came up radially to the disc assembly. When they reached the top, the discs were separated to permit the spears to drop onto a conveyor. They were put in boxes with all of the butts in one direction. This looked like a wonderful idea, and I'm sure its useable if we get into a situation where we don't have labor to do the job. In other words, you'd recover maybe eighty percent of that done by hand. So far this idea has never been accepted.

Dickman: But it's there.

Bainer: It's there; that's right. It's just like having a book on the shelf or a loaf of bread in the bakery. When somebody wants it they can go in and get it. He then modified the machine and put the knife far enough down in the ground so that he could cut white asparagus and then he brought this mass of asparagus and dirt up on a screen type conveyer where separating took place.

Dickman: I don't know the distinction between cutting for green or white.

Bainer: Well, the minute the asparagus comes through the ground the chlorophyll appears and it's green, and as long as you keep it underground it's white.

Dickman: And you can develop a stalk of six or seven inches under ground?

Bainer: Oh yes. You can go down a foot. See these roots are pretty deep and you cover the asparagus with dirt. You see you just pile dirt a foot deep on top of the asparagus. And this happens at the end of the season. You start out the season by cutting green asparagus. Right now [April] there's green asparagus on the market. Well, this is cut daily. Well, after a certain time the market for green asparagus is satisfied and the price declines. But there's still a big demand for canned white asparagus. That's about all you do with it. You don't eat it fresh as you do green asparagus.

Dickman: It's considered a delicacy in Europe.

Bainer: All the better hotels still serve white asparagus in salads. Well, he developed a machine that would go down and cut this stuff a foot deep, and as I say, worked the asparagus out of the soil by first bringing it up over a screen and screening it out and boxing the white asparagus. No orientation, just simply boxed. This showed some promise. But right now -- I don't know what the figures are -- but I understand that Taiwan has taken the white asparagus market away from us.

The green asparagus is also fast frozen. This is a very wonderful vegetable for freezing.

Tomato Research

Bainer: Now, when it came to tomatoes we were kind of the laughing stock around here when we mentioned that we were going to work on the harvesting of tomatoes. The tomato, as it was known then, was a perennial that continued to set fruit until frost. The crop didn't ripen uniformally, and therefore it was necessary to go in and make multiple pickings. At least two and sometimes three. And by the time you made your last picking these plants were lying on the ground.

It was very evident that if you were going to do this job you were going to have to have a different tomato because you had to have a plant that was of determinant type that set fruit and ripened over a short period of time. Jack Hanna of vegetable crops department tackled this problem. I'm told that Albert Jongeneel knew Jack because he had lived on Ryer Island and had done a lot of asparagus work there. Jongeneel was the man who was behind the development of the sugar beet harvester.

Bainer: Well, after the war, Jongeneel told Jack, "If you want to make a great reputation for yourself, you'll come up with a tomato plant that can be harvested mechanically."

Dickman: So he reached that idea independently?

Bainer: That's right. Independently. We had reached the idea that we were going to work on these various crops on our own.

Dickman: Including tomatoes?

Bainer: Including tomatoes. So Jack then got interested from the other side and we had Lorenzen interested from our side. Well Jack started out (I've heard him give this talk, I hope it's been recorded someplace) with the little tom thumb variety of tomato. He had one of those original plants that he started with, in a pot, as a demonstration, when he gave the talk on how he developed this tomato.

Dickman: Let me interrupt you just a moment. Jack Hanna and Coby Lorenzen of ag engineering, were working together now as a team?

Bainer: Yes.

Dickman: Deliberately on this project?

Bainer: Yes.

Dickman: And that you as chairman of the department had assigned them?

Bainer: That's right.

Dickman: Wasn't this one of the first times that these disciplines had been brought together -- the geneticist and the ag engineer?

Bainer: Yes, I would say that -- I have mentioned the grain sorghum work back in the '20s, but the engineer wasn't involved with the plant breeders. The plant breeders went ahead and did it. And then they invited the engineer to come in, and to me, that showed what a plant breeder could do toward changing a form or shape or characteristic of a crop to make it adaptable for mechanical harvesting.

Dickman: And to an extent you worked with a plant pathologist on the sugar beet?

Bainer: Oh yes. We had a reputation here of working with people -- we worked with the botanists on the beans. No one was changing

Bainer: anything much, you see, until Jack Hanna got into the act, and this I would say is an outstanding example of cooperation with the biological people. Well, anyway, Jack started out with the Tom Thumb tomato variety which had a couple of characteristics that he wanted. One was that it was a kind of determinant plant and the second was the tomatoes ripen up more uniformly. When he crossed it with other canning varieties he started coming up with some promising characteristics. All the while he was working, of course, Coby Lorenzen was working on a machine. The breeding program, as I recollect, took about eleven years, and it began to show very excellent progress in the final two or three years.

And then, of course, the situation that really set it off was when Congress terminated Public Law 78 in 1964 which had permitted the importation of foreign labor. And when Secretary Wirtz started to enforce this -- now, Wirtz got the blame for this change, but he was just following orders. Well, all of a sudden it was evident that we weren't going to get labor from Mexico, for picking our tomatoes. The best estimate that I've seen was that eighty-five percent of our canning tomatoes were picked by Mexican nationals! And if you withdraw that source of labor supply you're just going to be in trouble because you couldn't recruit domestic labor to do it. There were attempts to. They even had training schools at Davis to train people how to pick tomatoes. The pickers lasted anywhere from four to eight hours after training, when they really got out there where the work was. And you just couldn't keep a crew.

Well, there was a little liberalization of this order that made it possible to bring in some Mexicans for a year or so. Governor Brown called a meeting on the tomato situation and invited Coby Lorenzen, Kelly and me. And there were others there. He wanted to know what we were going to do now that we weren't going to have Mexican nationals?

Well, I told the governor, "We're working on this problem, and I would suggest that you persuade Secretary Wirtz to phase this program out over a period of three years. And I think at the end of the three years we'll have something that'll pick the tomatoes." Well, I don't think the governor believed that this would happen although he did, as I say, get some liberalization on labor importation. But, you see, the handwriting was on the wall.

To get back to the research story: In order to get seed you started out with single tomatoes, you had to start producing seed. So Jack Hanna started to grow tomatoes in Mexico, and

Bainer: in that way he got two seasons. He could go down there and raise a crop of seed and another crop of seed here.

I remember that the advisory committee of the Tomato Growers Association asked to come here for a meeting to see where we were. They were getting scared. After the meeting was over, they were quite encouraged by reports that Hanna and Coby gave them and they asked to see the prototype of the harvester. They had never seen it. And Coby showed them this prototype harvester. Well one of the Heringer boys (there's a group of Heringers that are big farmers down in the Delta) saw the machine. I think it was Les Heringer that was here. Well, when he saw that machine he said, "I have left one row of a paste type tomato. (These are little pear-shaped tomatoes.) We harvest these by shaking them off. We simply pull the plant and shake it over a blanket. We don't pick them individually. And when I took my last load out of the field there was a row left. We didn't have room for the row so we are going to disc it up. I would like to see that machine tried on those tomatoes. I think it'll handle them." He was a farmer, you see.

He told us where the field was and we told him we would bring the machine down the next day. Well Coby and I went down to the field after the meeting. We thought we should look at it. We thought it might be a wild goose-chase to take the machine down there. We weren't familiar with this particular strain. This made up maybe ten or fifteen percent of the total production; it was a different tomato. So we went down and played around with those tomatoes that evening and came to the conclusion that it did show some promise.

Well, we made a deal with Heringer. We told him that we'd bring the machine down there but we didn't want an audience. You see, this was just a prototype and if it failed we didn't want a lot of witnesses. Well, when we got down with the machine the next day there were about twenty farmers there. So the word had got around. Unfortunately the most important future man on this team was not there; that was E. Blackwelder. We never thought about having Blackwelder come. This machine just surprised everybody. And the next thing we knew Bob Heringer went to Blackwelder and ordered a machine. Well Blackwelder had no idea what the machine would cost, so he was going to build it on a cost-plus basis. The cost of all the parts plus a little for Blackwelder with no guarantees. He said, "I can't give you any guarantee that this machine is going to work." And then he, of course, saw the prototype. We loaned him this machine. He took it to Rio Vista and started working on a harvester.

Bainer: Well this harvester was coming along very well. So I went to the Statewide Dean of Agriculture D. G. Aldrich. We were thinking, "Here a farmer's going to have one of these machines, and we don't even have one to test out perhaps fifty varieties of tomatoes that Hanna had under cultivation." All of them had shown some promise. So I asked Dean Aldrich for enough money to buy a harvester. Have Blackwelder build us one when he was building one for Heringer. And boy, getting money was almost impossible. I don't know why we were so hard up then; this was before our austere period in the University.

I think Aldrich thought it was kind of a wild idea anyway. But finally Aldrich said, "Do you suppose Blackwelder would take a downpayment of fifty percent and have a little bit of an investment himself in this experimental unit and next year we'd pay the other fifty percent?" Well, Blackwelder was working on a pretty close margin all the time and he wasn't too warm to this idea, but he finally said he'd do it. Well, to make a long story short, I reported back to Aldrich. He had found the other fifty percent needed and we payed Blackwelder the whole amount when he delivered the machine.

Well, this was a very wise move because it gave us an opportunity to try a commercial unit on a whole group of varieties. Well, Heringers had that machine that first year and took out twelve hundred tons of tomatoes. This was the beginning. It gave farmers some confidence. Well, Blackwelder made too many machines the next year; he made about twenty-five units. We tried to hold him down because we felt there would be a lot of bugs; I mean, it was a brand new idea and we were working with a perishable crop. Well, he could have sold many more machines but he held the line at twenty-five machines. They had a lot of grief with them. So before the next season he took all twenty-five machines back and he rebuilt them according to the information learned in the tomato fields, and he didn't build anymore the second year.

Dickman: Now, were these machines used to harvest the kinds of tomatoes that Hanna was breeding?

Bainer: Yes. They wouldn't work on the standard varieties. This was a new variety -- F145 I think was the number. A limited amount of this seed was made available.

Dickman: So Hanna had selected one out of the several varieties he was working on?

Bainer: Well, he had selected one strain, what he called his 145 which was just a system geneticists use for numbering everything, and it still goes by number. I don't think it has any other name. And, of course, the seed companies are now producing the seed.

Dickman: What were the characteristics of that strain that made it --

Bainer: Several things. First it was a determinant plant.

Dickman: What does that mean?

Bainer: That means that it grows to a certain height and quits growing. It has a determinant growth characteristic. It sets its fruit very uniformally and ripens up over a three week period. If you started harvesting early in the three weeks you'd get more green fruit, if it was late in the three weeks you'd get more overripe fruit. But there was a range of three weeks that you could harvest. This was important. And then, of course, the new tomato was smaller.

Dickman: Was it shaped the same?

Bainer: Yes, that particular one was shaped the same. Smaller with a tougher skin.

Dickman: How about the look of the plant itself?

Bainer: Oh, it looked like the regular plant.

Dickman: It didn't grow upright?

Bainer: Oh, yes. It grew about as high as this table [about 2 1/2 ft.]

Dickman: But did the vines have a tendency to lie on the ground?

Bainer: You went in and cut the vine at the height of the yield. When you took these tomatoes off you simply severed the vine below the ground level and took the whole plant in the machine. That was the end of the vine. And you used the same principle to take those tomatoes off that you used to separate grain from straw in a combine. There was a shaking table like a straw rack in a harvester. So, another use of the combine principle was to separate the tomatoes from the vines. And then, there was a provision for conveying the fruit past workers who threw out green, damaged, and m isshapen fruit. What it really amounted to was about twelve people now did the work of sixty. But the work on this machine was so easy compared with the work of hand picking that women could be used for sorting.

Dickman: And how was the efficiency compared to hand labor?

Bainer: They got acceptable yields from these new varieties. It wasn't anything uncommon to get yields of twenty-five, thirty or thirty-five tons per acre in one picking. And that was as good as the hand method. There was lots of waste in the old method too, because between the two picking dates there would be a lot of tomatoes that would spoil, or were overripe. So that you had a big loss then. But with this system the losses were no greater than with the hand operation. Hanna was very fortunate in being able to develop a yield into this new variety which made it economical. But when you were out looking at one of these machines operate, you'd be appalled by the waste. I hope some day that they will be able to utilize this green fruit in some other way -- pickling or chow-chow or catsup. But so far they have harvested only ripe tomatoes.

Dickman: Where are most of the canneries located?

Bainer: Sacramento, Woodland, Davis and San Jose. Even down at Fullerton. The interesting thing is when I talked with Virgil Wodika of Hunts at Fullerton, this was three years ago -- they had grown tomatoes out on the desert near Blythe in the Palo Verde Valley on the Colorado River, and had to haul those tomatoes all the way to Fullerton which is over two hundred miles. They harvested at night when temperatures had cooled off and put them on the road in bulk bins, a thousand pounds of tomatoes in a bin, and hauled them all the way to Fullerton. I asked Wodika how they compared with tomatoes they were getting locally. He said, "The very best tomatoes we processed came from the desert." I'll talk about the work Mike O'Brien has done in bulk handling of tomatoes which helped make this long distance transport possible.

Then came the problem of how are you going to handle the tremendous volume of tomatoes that come off of the machine? So, that brought in another member of ag engineering, Mike O'Brien, to work on the bulk handling of tomatoes, and not only that, the sampling for grading before the tomatoes went to the cannery. They had to be carefully unloaded, and he had several mechanical problems there. Then there was a mold problem that developed in the large bulk bins. That brought in another team member to work on control of molds. I've omitted another very important member of this team, and that is the food technology people who came in the picture early to evaluate the product from the machine. In other words, you had to be able to come up with a finished product that was as good as we had had before. Even before they went as far as the farmer and the manufacturer, food technology was working with Hanna and Lorenzen here on

Bainer: campus in which they actually canned the tomatoes from the machine in order to determine the amount of solids and quality. They went clear through their taste panel to give their evaluation. So, you can see that this was all very important, and then later on the economists came in to make an economic study of the deal, and this was handled pretty much at the farm advisor level. See, farm advisors came into the picture -- not from the machine development or the variety development, but the production angle.

Dickman: You said earlier that O'Brien was able to put these tomatoes into four by four by four bins without crushing. How was he able to do that?

Bainer; I think it was because the actual pressure in these bins is carried on the walls. I don't think it was so much the tomatoes as the peaches in these big bins that had the problem with roller bruise. The tomatoes just kind of settled down in the bins. Now they've gone from bins to bulk loading in trucks. The unloading is done into a tank of water to prevent bruising.

The patent board gave Blackwelder an exclusive license for five years and then extended it for another five years. But in the meantime other manufacturers came into the picture in a rather small way. The fact that Blackwelder had the head start gave him the cream of the business. He sold a large number of machines, and once he had saturated the market, there wasn't much of a market left.

Now, you might say that we've been partial to Blackwelder, but this is not true. Everytime the patent board has had a machine to market, they have tried to involve people that they think might be interested. In the case of the tomato harvester, others were questioned as to whether or not they might want to get into the act. The International Harvester Company at Stockton and Massey-Ferguson at Fowler were invited to consider both the tomato and the grape harvester. Of course, the problem is that there's not enough volume in such items as these special harvesters to really be of interest to many of these companies. You have to have a small manufacturer like Blackwelder, and I hope we'll always have a Blackwelder in California to handle these less attractive items.

Now, I've noticed also that along this same line, when I was at the International Harvester Company seminar twenty years ago. It was about the time that International was moving into cotton harvesting machinery. I mentioned to President McCaffrey that I had seen a new model of a cotton picker made by John

Bainer: Deere. And I said, "It looks very similar to yours. Did you license John Deere to build one like yours?" He said, "In some instances we do." And I found out later that they do have a kind of agreement, a small license fee for the use of patents. He said, "When we bring in a new machine, we maintain exclusive production for two years, and then let other people build it. And with a two year headstart if we can't pick off the cream we don't deserve to be in the business." He told me another very interesting thing. It was a result of a question I asked him. I told him that years before a small company, by the name of New Holland Company, came out with an automatic tying hay baler, and they used twine. And this was the first real successful automatic tying baler on the market. I said, "They've got quite a headstart over everyone else." And Mr. McCaffrey said, "Yes, they did. They didn't even have a knotter to tie the twine. We sold them the knotters. And pretty soon they had their business up to 18 or 19 thousand machines a year and we were selling them the knotters. We thought we'd better get into this business." And so, everybody and his brother moved in on automatic tying balers. Then they got into wire tyers or twisters or whatever you want to call them. But a small company lead the pack. It wasn't any bigger than Blackwelder at that time. Well now, Sperry Rand has bought them out. It's a company that's doing a big haying machinery business. They've made some other developments like the hay conditioner which really proved to the world that there was a demand for hay conditioners. Again every farm machinery company is in the act.

A little sidelight on this tomato picture: I served on the Agriculture Board of the National Academy of Science for about five years -- I was the only engineer on this board. We had frequent meetings in Washington. There were some very wonderful people on this board; Directors of Experiment Stations and Deans and geneticists,etc. I remember one in particular, Dr. N. J. Volk who was the director of the experiment station at Purdue. He, of course, was aware of what was going on around the country. And at one of these meetings he said, "Well, you know, the work that you people are doing in California is going to be so competitive that we will no longer be able to produce tomatoes for canning. We can't compete with you." You know, it surprised me. I said, "Well, listen. In Indiana you can grow tomatoes for half of what it costs us to grow them in California. You don't have the irrigation problem, you don't have the insect problem, you don't have the high land values, and all those things that go with it. Your costs would be way below ours." "Well, sure," he said, "I'll agree to all that. But, the big cost in the tomato is picking it. And if we

Bainer: can't use a machine, we can't compete. We can't depend on a machine because we can't depend on the weather. We may get a rain at the time the tomatoes are ripe; we can't put that machine in there because you can't 'mud 'em out' and we'd just lose them. You can put hand pickers in there after a rain and pick them, but you can't put a machine in there." And he was right.

Dickman: What's happened to the tomato business in other areas of the U.S.?

Bainer: Well, they're not competitive now. There have been some tomato harvesters used back in New Jersey, I'm sure. But it's a gamble on account of rain. In California we normally can get our tomatoes out, without rain. Now, of course, if we get rain we're in just as bad shape as they are.

When we really got going in this tomato production there was an overproduction. It was so easy to produce, and I think we had over two hundred thousand acres. The canneries had contracted more than they should have. You see, tomatoes are a contracted crop. You don't grow them unless you have a contract. But the thing is that we had an overproduction and then a cut back.

Dickman: What percentage of the total tomato crop goes into canning; most of it?

Bainer: Oh yes, a high percentage of it. California, with this mechanization, is the main producer of canned tomatoes. I don't know exactly but I would say somewhere between seventy-five and eighty-five percent of all the processed tomatoes in the United States are produced right here in California. So we did maintain an industry which was very important to California, by this mechanization. And people do not realize how many jobs depend upon the tomato. When you begin to think about all the people down the line that are involved; you have the transportation from the raw product to the finished product which involves trucking and the railroads. This stuff goes all over the United States. You have the people involved in the processing, in the canneries, the steel makers of the can, the wrappers and labels on the can, the printing, advertisers, bankers,etc. I figured this industry was worth half a billion dollars a year to California and we were about to lose it.

I failed to mention another facet of this. When it was announced that we weren't going to have labor, the processors began to look elsewhere for a place to grow tomatoes. And

Bainer: they began to investigate Mexico because they can grow tomatoes in Mexico. I went to Guatemala on a consulting trip and I found out they'd been down there checking on the possibility of growing tomatoes in Guatemala and processing with local labor. We almost lost this industry -- it was just one of those things that was timed just about perfectly. Same with the sugar beet research. We started with sugar beets in '38, and the war came along in '41. By then we were far enough along that we could accelerate the program to compensate for lost farm labor. So I think the forward look that was taken in the late '40s was very important in having something ready when the problem became acute. This is where the University is in a key spot, and I think we're losing some of this attitude right now. I don't think we're thinking as aggressively on problems that might come. As I say, I can still hear people laugh when we talked about harvesting tomatoes, but they had no imagination and no concept of how things could be changed to make it possible.

Dickman: That's the old story? "Without vision the people perish."

Bainer: [Laughter] That's right.

Lettuce Harvesting

Dickman: How about lettuce?

Bainer: This, of course, was another important vegetable crop we decided was worthy of some work. So Roger Garrett who I've mentioned was a new man in ag engineering, was asked to work on the harvesting of lettuce. He made quite a few studies and then came up with a prototype machine that involved several things. Lettuce is normally harvested by hand. It may be brought into a central packing plant or packed in the field. It isn't harvested until it's of a certain size and certain density -- certain firmness.

Dickman: We're talking about head lettuce?

Bainer: Yes, head lettuce. This was the only variety we were involved in. And so he developed a sensing device that determined when this head was firm enough for harvest. It was physically not impossible but difficult to have the knife take that head out at the time it was sensed to be ready, so they had to develop in this harvester a memory device which held the information from the sensor while the machine moved ahead maybe a foot or

Bainer: a foot and a half, and then a cutting device was actuated to cut that particular head. Lettuce is thinned to a spacing of twelve to fourteen inches in a row. These are individual heads, otherwise you wouldn't get the shape. So they have to be pretty well thinned. So here was a machine that would grasp the heads as they were severed, and deliver them up to a conveyor.

This was a sophisticated machine that demonstrated merit. It would select and cut the heads that were ready. As long as farmers have labor in the Salinas Valley, they are not interested in mechanical harvesting. In some instances, labor has prevented field trials with machines. They just say, "Nothing doing. Keep your machines away." So it makes it a little difficult when a farmer in times past had the freedom to at least bring machinery in and give it a whirl. The same thing happens in grapes. There are contracts, for instance, Almaden signed one contract with labor which prohibits even trying out a grape harvester. This is one way, of course, that organized labor is holding back progress in some of these fields.

We have, in the college of engineering, several disciplines; one is in the applied science area where we were working and using the facilities of the Radiation Laboratory at Livermore. This is only for the peaceful use of atomic energy. Wilson Talley who is Vice Chairman in the department of applied science (he is now assistant to the vice president and the department lost him, he is a good man) got interested in the lettuce harvester. This is the advantage of having a whole group of people all housed together. He talked with Roger Garrett and they began to study the possibility of bombarding this head of lettuce with gamma ray. Not only could they determine the density with gamma ray bombardment, they could also get the size, which Garrett wasn't able to do before. They calculated that the amount of radiation that would be given to the plant was equivalent to about five hours sunshine, so this wouldn't hurt anyone.

They had to get a clearance from the Atomic Energy Commission to use this unit, and of course, there have to be all kinds of safety features. They still haven't got the clearance. They've been doing some work on harvesting, but they don't have the clearance to go commercial on this thing yet. And yet here is the idea: to just simply move down the row and these rays are directed through the row, and when they hit a head of lettuce determine the density.

Dickman: I understand it's so sensitive toward the end of the season they can set it to accept heads that aren't quite as dense.

Bainer: Yes, that's right. It's adjustable. You can take off whatever information you want it to. The beauty of it is you can have your sensing and your knife practically together. It eliminates the memory device. So here we are with an idea -- and we're not the only one working on this thing. I have mentioned the USDA man by the name of Adrian, who worked with Fridley on fruit harvesting, the inertia shakers etc. And then USDA got pressure from Salinas Valley to station people down there working on lettuce and other problems. So, they move Adrian down there. Adrian continues to cooperate with Garrett and does a substantial amount of work on his own. And also, the University of Arizona got into this act and they are working with methods for determining density. And I don't think they have studied gamma ray bombardment, but they have a machine in Arizona now that's been tried in California that shows promise. So here again we have equipment that, if we really got in to a bind with lack of labor or high cost of labor, can do this job. Adrian has been working with x-ray for determining density.

Dickman: Has there been much literature published on lettuce harvesters?

Bainer: Some in ag engineering journals and transactions.

Dickman: Is there any way to keep track of what is being done at other universities, or is it just straight out and out competition?

Bainer: No, no, it's cooperation.

Dickman: So that you don't work on the same things?

Bainer: Oh, we do work on the same things. There are many instances where different institutions like Arizona and California are working on a lettuce harvester and have been for several years, but we know what they're doing and they know what we are doing. I mean there isn't anything secret about this. And the same thing happened in sugar beets or anything else -- tomato harvesting, for example. There were several companies building tomato harvesters and some of them aren't even in California. So that there's just something about a problem that somebody starts and begins to get some answers, and you find that other people want to jump in and get on the bandwagon.

Dickman: Or arrive at it independently.

Bainer: Yes, independently. And independent research is helpful. We don't feel that we're really in competition.

MORE RESEARCH PROJECTS:

Rodent Control

Dickman: For a change of pace let's talk about animals and animal environment. Let's include rodent control. I understand gophers can be a problem.

Bainer: Yes, they can. A few years ago there was a trend toward improved pastures, irrigated pastures. And one of the enemies of a good pasture is a gopher. He likes the roots of good pastures, and under these favorable feeding conditions, the gopher population grows pretty fast. It concerned Dr. Paul Sharp who was the director of the experiment station. He had observed the tremendous damage that pocket gophers were causing in these beautiful, lush, irrigated pastures. The gopher, as you know, works at an eight or ten inch level below ground, and he digs the dirt and forms more or less a pocket between his chest and forelegs, and pushes that dirt up out of his burrow through the surface of the ground, and piles mounds of dirt. That interferes with any clipping or maintenance that you might want to do later on. Certain pastures are left to go for seed,etc. Well, anyway, here was a very serious problem.

Sharp called a meeting at Davis, and invited everyone he thought could make any contribution to the solution of the problem. This included people in agronomy, ag engineers and zoology; extension people. There were, I would say, ten or fifteen people and we talked all afternoon. There were many different methods brought up that were suitable for controlling gophers. They could be trapped, poisoned or gassed. Well, anyway, everything that was proposed had some merit, but none were economical. You just couldn't afford to control gophers by any method that was brought up that afternoon. Well, I felt bad, I really did. I went away from that meeting thinking we spent all afternoon, and nothing constructive, or anything in the way of a solution came up.

Well, the next morning Howdy Howard called me. Howdy Howard is a vertebrate ecologist.

Dickman: Applied zoology.

Bainer: Yes, it's really applied zoology. He called me and said, "You know, I've been racking my brain ever since that meeting yesterday, and I'd like to come over and talk to you." So he came over and started to tell me about the life history of a gopher,

Bainer: which was an interesting story. And as he progressed I said, "Let's get Kepner in here." I could see he was beginning to lead up to something. So Kepner listened to this story. Howard had an idea. If you knew the life history of a gopher, you knew how and where he was working. The gopher worked at a pretty uniform depth and he was an explorer. If he intercepted another burrow, he explored that burrow from one end to another, and they all worked alone except during the mating season. Every gopher had his own run. But he was a very curious animal. Howard said, "Would you fellows know how to make an artificial gopher run?" And he described it. And I said, "Yes, it would be easy." If you pulled a mole in irrigated soil used in mole drainage, it will open a cylindrical passage way. The mole is a little billet that is attached by chain to a vertical standard.

Well, he said, "If you could put the artificial gopher run in at let's say an average depth of ten inches, you'd intercept the runs that are there. If you could make a hollow standard with a metering device on top you could drop poisoned grain in the artificial gopher run. Then when the gopher intercepts this artificial run he'd eat the grain and die underground -- and you wouldn't have any disposal problem."

Well, this sounded great. The problem was we didn't know how close to put these runs in the field. Kepner built a device that would make an artificial gopher run. It consisted of a narrow standard with a metering device that metered the poisoned grain and a tube that led the grain in the run. It didn't tear up the surface at all. After it went through you really had to get down on your hands and knees to find them. There was a hundred acres of pasture available to try out the idea. They decided that they'd make these gopher burrows 20 feet apart. They had made a count of the gopher activity in this field, and then they put in the poison bait. This was a fast operation, because you could operate at four or five miles an hour. This meant covering about 80 acres per day. The economics of this operation was wonderful.

The interesting thing was that one treatment in that field reduced the gopher population to a point where then you could afford to go in by hand and clean up the few remaining gophers by trapping.

And, do you think Sharp wasn't excited by this! I think he went home that night just completely baffled with a failure, and then, when this thing showed up on the scene, it was really something. I don't think we ever did anything around here that really struck his fancy like that one little demonstration.

Dickman: This may be the place for me to ask, what is the relationship of an agricultural experiment station to the research done?

Bainer: Well, the agricultural experiment station is the research arm of the University in agriculture. In ag engineering we had two titles: professor of ag engineering and ag engineer in the experiment station.

Now, one more phase of this thing. Kepner worked up plans so that a farmer could buy standard parts and build a machine. He also furnished plans so that Blackwelder could build machines commercially. So there were two methods a farmer could use. He could either build himself or buy from Blackwelder. To me it was a fantastic little short experiment. It was almost gadgetry in a way, but it was research. After all, Howdie Howard knew all the habits on the gopher. I'd really like to go back and make a study of that little animal because he's a real sharp little guy. [Laughter] But we were sharper than he was.

Dickman: And Sharp was happiest of all.

Bainer: [Laughter] And Sharp was happiest of all.

Environmental Research for Animals

Bainer: Well, another very, very important animal problem in California is the environmental problem of animals that are produced in the warmer regions of the state. The Imperial Valley has the reputation for very hot weather. This is an area that produces tremendous amounts of feed. Alfalfa hay is a big crop in the Imperial Valley, and this hay for years and years was transported out of the valley to feed lots and to dairies in the Los Angeles area, primarily. This seemed ridiculous to a lot of people, and they thought they would like to feed the animals in the Imperial Valley and take the animals out after the feed conversion.

The problem, of course, was heat in the summer. Now the fall, winter and spring was wonderful weather for fattening up animals, but to carry them through the summer was something else. A joint project was set up between ag engineering and animal husbandry to make studies of methods of changing the immediate environment, the micro climate, around these animals. And I've mentioned Clarence Kelly who was stationed here by USDA to work on environmental problems in relation to animals. He was tied

Bainer: in with animal husbandry. (Walker spent some time on this project.) And they set up their operation east of El Centro at the Imperial Valley experiment station of the University of California. There was a young man there, a graduate of Davis, by the name of Nick Ittner who was the animal husbandry man at Imperial. So, it was really Ittner and Kelly and eventually Ted Bond, one of our graduates,who went to work for Kelly on this project.

They started to modify the environment of these animals. Well, the first thing you do is take the heat load off the animal by shading it. They found that during these extreme hot summer months, an animal with no protection from the sun would not eat enough feed to maintain its weight. This was how serious it was. But if you put shade over them and break that heat load, they start to eat more and gain weight. They got more benefit from shade than from anything else.

They also did other things. They noticed that the animals in pens fenced with wire outgained the animals in pens fenced with wood boards. They took measurements and found there was more air movement in the wire pens than in the board pens even though there was space between the boards. Well that gave them the idea of producing artificial wind, and this helped under certain conditions. It looked like a world beater for a while, if you could just move air at about six mph through these pens. This gave them some very significant weight gains.

Dickman: This was regular air and not refrigerated?

Bainer: No, this was regular air. Just moving air. Now, a cow doesn't have sweat glands, I understand, but there must be a transfer of heat through the hide. I don't understand the physiology of a cow, but it's influenced, certainly, by the heat load it's subjected to. Well, they did a lot on shades. (Companies gave them aluminum and steel sheets to make shades out of.) They tried different heights and different exposures. I remember there was no better shade than just a frame work with some hay up there, a very simple shade. They got some benefit from cooling the drinking water. The drinking water was cooled from say ninety-five degree ditch water that the animals were drinking down to a dew point temperature of sixty-five degrees approximately. This made a tremendous difference in stimulating the appetite of animals.

They tried shower baths fixed up over an irrigation ditch so that the drainage went in the ditch and didn't make a mess. They arranged it so that as the animal came out of the corral

Bainer: and went over a little bridge over the irrigation ditch, an electric eye would turn on the shower. As the cow moved on, the shower turned off, and that gave them a wet coat and a wet coat gave them evaporative cooling.

Dickman: Did they have any trouble with any of them that didn't want to get out of the shower?

Bainer: That's exactly what happened. They'd get in there and stay. So they arranged for the shower to run so long and then shut itself off. Then the cow would move on. All of these methods had an effect on gains in weight. They next provided a mist just to keep them wet and cool them by evaporation. They even tried to refrigerate the feed bunks so that when the animal put its head in the feed bunk, it would cool his head. This was a little bit farfetched, but it had an effect.

To sum it all up, they were able to improve gains of animals and make it very worthwhile to feed them right through the summer. They were putting about two and a half pounds a day on an animal right through the hot weather which is as good as you can do in Iowa, in a feed lot. And so there are thousands and thousands head of cattle down in that area, all over the desert, including the Blythe area. I understand more are being fed in Texas and Kansas now, so we're losing some of our business, but there are still thousands and thousands. And many are in the Bakersfield area where there's lots of feed produced and available.

There's another animal that they worked with, and that was the hog. They did this work at Davis in the psychrometric chambers here. They determined the climatic conditions that were most ideal for weight gain on the pig. And they determined that for a hundred pound hog that was something like seventy degrees, and sixty percent relative humidity.

They determined the basic conditions under which these hogs would do their best. And this was given some national publicity. Their only problem was that this was a continuous day and night sort of thing in a controlled chamber and when you brought your hogs out into the natural conditions, you have the temperatures high in the daytime and cool at night. And so the break in this temperature apparently takes care of a lot, as far as the hog is concerned. So even though in the control chamber you could show the condition, you couldn't duplicate it in the field. They wanted to carry some hogs down in Imperial and this isn't hog country. I want to tell you, it's too hot for hogs. They set up an experiment involving hogs, and they used pens with refriger-

Bainer: ated slabs so that a hog could lay on the cool slab and cool off. Check lots of hogs didn't have refrigerated slabs, but they had a wallow to wallow around in. Apparently it is very essential for a hog to be able to cool off one way or another: evaporative cooling or from wallowing in the mud. In this experiment, they began to notice that the check lots were outgaining the ones on the refrigerated slabs. And then, of course, being true scientists they had to find out why in the world you were getting this difference. Well, what it really summed up to was that they'd made it so comfortable for those hogs lying on refrigerated slabs they wouldn't get up to eat.

Dickman: I didn't think that California had enough hogs to warrant that kind of research.

Bainer: Oh yes, there are quite a few hogs produced in California. And probably more now. Of course we have a lot of garbage fed hogs, you know, around the cities. Then with corn coming into California more hogs are produced. I don't know what the hog population is in California, it goes up and down, but there are quite a few hogs.

Starling Control

Dickman: When they were feeding the cattle, did they have a little trouble with the bird called the starling?

Bainer: Yes, we had that all over the state. It's not just in the Imperial Valley, but even in the north, in the Sacramento Valley. This starling is a serious menace, there's no question about it. Apparently they multiply very fast and whole flocks of them move into a livestock feeding plant and not only do they eat the feed that is intended for the livestock, but they defecate on it and then the livestock won't eat it, and it's just very, very serious. This isn't the only thing they do. They'll move into a fig orchard, in the Fresno area, for example, and pick holes in the figs, and maybe just one hole, but that one hole is enough. So, under our CREA program we had a project on starling control and tried various methods. Some in which we baited traps and had a high voltage arrangement that would electrocute them. Well, this wasn't a very popular way, you know, to dispose of birds, and it wasn't taken up.

Now, I understand they have some poison that affects starlings only, and they've even worked on colors that would attract starlings to the feed. I'm not familiar enough with that to

Bainer: say anything, but I just heard last week that there was some selective poison that starlings would take and other birds wouldn't take.

One of the methods that we did try: first they'd catch some starlings and once they're harassed or caught, of course, they issue a very startling cry, and this cry then was taped. We called it a distress call -- they're in distress and they call for help, or at least warning other starlings to stay away from here, "I'm in trouble." So, this distress call was reproduced and amplified and played in some of these orchards. We set it up in Fresno, once, in a fig orchard. A farmer wanted some help, so we set this up. Well, it kept the birds out of his orchard, but they just moved to another orchard. So, I don't know if you could have enough of them to keep them out of all orchards, but it did have an effect; it did move birds when they heard this distress signal.

Another method that we didn't have anything to do with, but did observe, was a periodic explosion. There are devices on the market that apparently generate a little acetylene gas which gets up to a certain level and it takes off, sounds like a shot gun, at irregular intervals. Well, everytime that explosion takes place the birds would lift off and fly.

So far, I would say that we just don't have an answer. Now, they did use these distress calls around these feed bunks, with some tendency to keep the starlings away, but it's very difficult to deal with this problem.

Metal Detection in Hay

Dickman: Let me ask you, how did they detect metal, or was there a problem of metal in chopped hay?

Bainer: Yes, there was. Because for many, many years hay was cured in the field and baled from the windrow and the baling was done in a machine that tied the bales up with wire. At first they were manually placed and tied around the bale, and finally automatic balers appeared. And the situation is that when they were fed directly from the bale without any further processing, the bale wire wasn't a factor, but when they began to chop baled hay to feed the animals, there was occasionally a piece of wire that got into the chopper and was chopped up the same length as the hay.

Dickman: Would this kill an animal?

Bainer: Oh yes, this was a lethal instrument. See, the cow is rather careless in her feeding habits. As you know, she forages and gathers hay or grass and swallows it to the first stomach where it's developed into a cud and then she regurgitates and chews it again and then it goes further along the digestive system. So it's very easy for a cow, for example, to take in a wad of chopped hay that may include a piece of wire. Well, we were told by the veterinarians that a high percentage of the calls to dairies and beef feeding plants were to treat so-called hardware disease. Hardware disease may be caused from swallowing wire, nails, or fence staples, etc. This was a CREA project. John Dobie and Fred Jacob were CREA engineers at the time. They developed a metal detecting and rejecting system on a stationary chopper first. Later, one was attached to a field chopper. It consisted of a coil wound around a fiber glass section which was mounted in the discharge pipe. This coil was similar to a motor winding and was magnetized by an external current. As hay containing iron progressed through the center of the coil, the iron pieces would cut the magnetic lines of force in the coil. This produced a signal that could be amplified and used to open a gate momentarily to let out about a half a pound of hay that carried the iron. And remember they're working at velocities up around six or eight thousand feet a minute. This is a pretty fast operation, but the device was very effective. Previously permanent magnetic plates had been installed in the pipe where the material was deflected, e.g. in elbows. Iron pieces were attracted and held on the magnetic plate. These were effective to a certain extent, but as iron collected on these magnets, there was a tendency for the hay coming along to wipe it off.

They installed the detector at a dairy near Fresno, where the man already had a magnetic plate in the line. The farm advisor made the arrangements, and when they got down there the man wasn't too keen about disturbing his setup because he had a permanent magnet in the system, and was collecting iron from this machine. He finally gave in and said, "If you fellows will put your separator at some distance above the magnetic plate, OK." So here was an installation of the electronic metal detector beyond the point where the permanet magnets are located, and it gave it a chance to check upon what the permanent magnets were catching. Well, after a few days of operation they were getting more metal from the electronic detector than they were on the magnetic plate which indicated that the permanent magnet wasn't too efficient.

Then, of course, came along the practice of field chopping. In field chopping, the interesting thing was that there were strands

Bainer: of baling wire from prior baling operations left in the fields. This baling wire was raked up with the hay. Then when they picked up from the windrow and chopped and blew it onto a van to take into the storage point, this wire was chopped up along with the hay. So that Dobie and Jacob adapted this metal detecting device that was used on a stationary machine to the portable machine. They had a deflector in the line to the van which would flip open everytime a piece of metal was detected and let out a little hay with the metal. In the meantime, veterinarians (just to show you how a problem was at least partly solved to the point where they didn't need to go to all this fuss of detecting metal in the hay)-

Dickman: They bred a cow that could digest iron.

Bainer: No sir, they fed permanent magnets into the stomach of a cow. These magnets are about a half inch in diameter and maybe three inches long, round with curved ends. They simply introduced those magnets into the stomach and when they were digesting their food, if there was some stray iron in there it collected on the magnet. The magnet was removed when the animal was slaughtered.

Dickman: [Laughter] That's fantastic.

Bainer: Yes, it is, but here's a beautiful idea of metal detection that could be adapted to either stationary or field chopping. John Dobie started work on hay pelleting in 1957. Alfalfa hay was first ground and then fed through a pellet mill. The density of the pellets was about 45 lbs. per cu. ft. vs. 10 lbs. for baled hay. The pelleted hay was fed mainly to poultry and dairy cows.

In 1959, he became involved with wafering of hay in the field, using a machine being developed by the Ford tractor division. Following this (1960) he started studies on cubing of hay. One of the earliest machines was built by the Johnson Machine Co., then located in Davis. It forced hay, taken from the windrow, through dies that produced cubes of one square inch cross section.

This work was accelerated when John Deere came on the market with a hay cuber. This machine had a capacity of around 4 tons per hour. It was portable and took cured hay directly from the windrow. The density ratio of cubes to baled hay is about 2 1/2 to 1.

Pelleting and cubing produces a product that is more easily handled, takes less storage space, and can be shipped long distances. Some of the cubed hay has been shipped to Japan. Today (1973) about 10 percent of the alfalfa produced in California is

Bainer: cubed.

You questioned the amount of money supplied by CREA to the University for research on the use of electricity in agriculture. Starting in 1924, the donation amounted to only $1,000. During the next few years it increased to $6,000 to $8,000 per year, and then gradually increased to over $40,000 in 1973. The total funds supplied during the 50 years of operation amounted to approximately three-quarters of a million dollars. Without a doubt, this has been the longest period of continuous support the University has received from an outside commercial agency.

Many projects in agricultural engineering involving the use of electricity have been supported by departmental funds or by other agencies. Typical examples are: electronic color sorting of fruits and vegetables, forced air cooling of fruit, prune pitting, apricot cutting, etc.

Small Seed Legumes

Dickman: Will you talk about the research in small seed legumes?

Bainer: After the war there was great acceleration in the use of improved pastures throughout the United States. The land that was taken out of cultivation and put into grass was a land bank sort of a deal. And there was a tremendous demand for legume pasture grass seeds, including alfalfa and clovers of different types. Many tons of seed were needed and were produced at a very excellent price in California for a number of years. We had a seed certification program in California under Frank Parsons. They were interested in the quality of this seed that was being produced in California and sold throughout the United States. They found that germinations were down in this seed, and the agronomy department assigned the problem to Luther Jones to do something about it. And when they got into this thing along about 1948, agronomy called me, and asked if it would be possible to get some help on the harvesting of small seed legumes. That they were experiencing this germination problem.

Well, like so many things, this request came fairly late in the season and at a time when everyone was busy and had plans for the balance of the year. Well, I talked with Fairbank. Fairbank was in our department at that time. There was an interim that Fairbank had left extension and joined our staff. I also talked to Kepner, and a young fellow coming into the department about that time by the name of Philip Bunnelle. Bunnelle was a

Bainer: graduate in mechanical engineering from Berkeley who came to Davis and took his master's degree in ag engineering.

Well we decided that among the four of us, that is, Fairbank, Bunnelle, Kepner and me, that maybe we could alternate week by week, and each one of us, maybe spend a week or two with Jones in the field.

Dickman: What did he want you to do?

Bainer: He wanted us to study the machine aspects of this threshing to see whether or not there was any correlation between machine adjustments and the quality of the product.

Dickman: They were getting seed damage again?

Bainer: Yes, seed damage. I was anxious to do it because I was just positive that some of the information that Borthwick and I got on beans might be applicable to alfalfa and clover.

Well, anyway, it was agreed that that's what we'd do. And I think the first trip or so we all went out to get the picture and to get organized. Jones was a great guy to work with because he had a facility of getting data analyzed rapidly and the situation was that as you made changes in these machines he was able to detect any improvments made. Well, within one year it was very evident that it was similar to the problem with beans. Impact damage in the machine. And it was a matter of slowing cylinders and maintaining speeds in the separators, which had come up in the beans.

It was interesting that the flax rolls that were introduced at the time we worked on the flax problem in the Imperial Valley could be used when threshing legumes. The flax rolls were mounted ahead of the cylinder and acted as retarder rolls. Now this sounds a little bit absurd. The legumes are cut and windrowed, and left in the windrow to cure. When cured, they are picked up from the windrow and threshed. There's always a certain amount of tangle in the windrow. And one of our problems, especially if it happened to be a little damp, was that the cylinder, which ran at four thousand feet per minute, pulled in more of the windrow than it could handle. You must remember that the forward speed of the machine was only a couple of hundred feet a minute. During operation, the windrow is entering the machine at a very slow speed and all of a sudden the cylinder takes it and may pull in ten or fifteen feet of windrow, and the first thing you know the cylinder goes "boom" and it stops. It just wraps up and it's an awful job to clean the cylinder.

Bainer: The peripheral speed of the rolls was slightly faster than the forward speed of the machine. The retarding action of the flax rolls resulted in feeding the cylinder uniformily, so here was an idea that came 15 or 20 years before introduced into a new operation.

Dickman: You know, you would have thought that some manufacturer would have picked it up and you wouldn't have had to do that work twice.

Bainer: Well, we didn't really have to do it twice. We just simply adapted an old idea to help solve a new problem. Well, anyway, within a matter of a year there was a tremendous improvement in the quality of the seed that was produced in California. And we felt pretty good to walk in on a project, and apply what we already knew.

Well, then we got into a tremendous problem which resulted from an introduction from Kentucky. The Kentucky experiment station came out with the new clover which they called Kenland clover, and unbelieveably they could not produce this seed in Kentucky because of the weather. So they shipped out a hundred pounds of the foundation seed for reproduction. I'm told that they split this hundred pounds three ways and Bernell Harlan and Theo Dumars on the Plainfield Road north of town, received about thirty pounds of this seed. They had a contract to reproduce this clover seed for $1.50 per pound, which was a pretty good deal. They took the seed to Los Angeles and had it coated. It was planted with a sugar beet planter at the rate of one pound of the original seed per acre in rows that were three or four feet apart, and cultivated. As the harvest approached you never saw such a production of forage material in your life. And Harlan began to worry how he was going to harvest it.

I went up and took a look and boy, they had a growth there that just looked like it was impossible to handle. So I called the chief engineer of the John Deere Company in Moline, Illinois, and I told him about our problem. And I said, I want you to send out the man who designed their "55" combine and we'd show him a real harvesting problem. And he agreed to do it. And this man came out. Well, he didn't know anymore about threshing small seed legumes than we did. It was an advantage however, in having him here because he knew where to get accessory materials that we wanted to try out. And, of course, he could pitch right in and help modify the machine. He arrived by the time Harlan and Dumars had windrowed the crop. They had only put about six feet of swath in a windrow. We pulled into that field as the machine was set, and put a blanket under the rear to catch everything that went through. At the same time we caught every-

Bainer: thing that went into the seed bin. After running a short distance we stopped and analyzed what we had. Twenty percent of that crop was on that sheet coming through the machine -- twenty percent, and we figured roughly at that time from the area we covered that the yield would be somewhere around 800 pounds of seed per acre. That's twelve hundred dollars worth of seed, and twenty percent of it going over the tail end. You couldn't afford to do that.

Well, was I glad that I had that man from John Deere here. He immediately saw the problem. Well, what do you do? Well, there were several things you could try. We brought the machine into our shop and started reworking it. We put an auxiliary scalping sieve in the shoe. A jackshaft was installed to cut the forward speed by 50 percent and made several other modifications. By the end of the week we had the machine back in the field. And the same types of tests showed that we were down to about one and a half to two percent loss.

Dickman: That's fantastic, to go from twenty percent to one and a half to two percent.

Bainer: That thirty acres produced about $36,000 worth of seed --

Dickman: Compared to -- they were using what, ladino?

Bainer: No, this wasn't really competitive to the ladino clover. This was a new variety. Of course, you don't get that kind of price for it once you get into production. But still at sixty cents a pound, a loss of 20% over the tail end would be terrific -- $100 an acre, or thereabouts.

Dickman: Is that what you're using now?

Bainer: Well, yes, it's one of the seeds. The primary forage seeds that are produced are alfalfa and ladino clover. Now, ladino clover behaved entirely different from alfalfa. We had very little to do with it except to study machines that were developed in that area around Orland. They used a suction just like a vacuum cleaner that would lift the seed and run it through a thresher. The cylinder speeds when threshing ladino were 50 percent higher than used in alfalfa.

Well anyway, this was a big industry in California for a long time and still is. I mean it still is an important seed crop and the germination was raised by simply modifying the machine operation.

Corn Harvesting

Dickman: Let's go from that to corn harvesting.

Bainer: Well there was a project that I was able to get my teeth into even though I was chairman of the department. I found it difficult to find enough time to do a lot of work in the field. The corn project came at a time when there was a curtailment on the acreage allotment for sugar beet, cotton and rice. And the farmers of California that grew these crops were looking for another crop to substitute. And while there were allotments on corn in the middle west, there were no allotments in California. We were importing from the middle west about the equivalent corn that could be produced on say a third of a million acres.

So we were getting into a situation where corn was coming in -- we didn't know for how long, because certainly the farmer that grew cotton at the price they were getting for cotton wouldn't grow corn if he could grow cotton. So if they lifted the allotment, why he'd go right back to cotton. As a result we had very few corn producers in California. There was corn produced in the Delta region that was picked by regular corn pickers, but when you got into the Bakersfield area or Blythe or wherever you were in general, you just didn't have any corn.

Dickman: About what year was this? Was it in the '50s?

Bainer: Yes. 1954. There was a machine shop operator by the name of Wim Leyly at Orland. He had built some of the suction harvesters for use on ladino clover. One day the farm advisor, Milton D. Miller, at Orland called me and asked me to come to Orland to see a demonstration of a machine that Wim Leyly had developed for handling corn, ear corn. He had installed a mechanism on an AC combine for handling the stalks of corn. The whole stalk with the ears was run into the machine.

He was doing a beautiful job of shelling the corn right off the cob. It was really unbelieveable what they were able to do. Of course, the approach was all wrong, mainly in the introduction of the stalk. He was cutting the stalk off and running it through when all he wanted was the corn off the cob.

The University of Illinois had done some work to demonstrate the rasp bar cylinder was a good substitute for a corn sheller. In other words, that it could successfully shell corn, but nobody was doing anything except -- oh, there had been some attempts if you look back in the literature clear back to 1930 where they had tried to introduce the corn into the combines and everybody went at it wrong. They all went at it by cutting

Bainer: off the stalk, and you've got a big clumsy thing to handle when you take a corn stalk into a combine. It's a pretty heavy load in the machine.

By 1954 it was evident we were going to have to do something because we were beginning to produce more corn in California. We decided the approach was to snap the ear off the stalk and leave the stalk in the field and just feed the ears into the combine. It was very evident to us that companies that built snappers and corn pickers already knew how to do that. A very fortunate thing happened (it was embarrassing, I'll say at the start). I had been critical of International Harvester for their lack of cooperation in our small seed legume threshing experiment. The president of the company had a representative who came to Davis periodically to see what was going on. His name was Archie Stone. I told Archie that I was very unhappy, that we weren't getting the cooperation that I thought we should have.

Well, to make a long story short this all got back to the president of the company and the next thing I knew I was invited to come to Chicago to see him. When I walked into his office there sat Mr. John McCaffrey who was president, and three or four executive vice presidents. And I thought, "Boy, if there ever was a lamb led to slaughter, here I was." Well, Mr. McCaffrey said, "Mr. Bainer. I have read with great interest Archie Stone's report about his interview with you in which you made considerable criticism of the company, and" he said, "I have personally looked into this thing, and everything you have said is true. What can we do? What's your next project?" Boy, I'll tell you. I never was so relieved in my life. I thought "This can't be true." I thought these guys would just give me a bad going over. "Well," I said, "you know, we've got a new project and you people can certainly help. We want some snapping units put on the front of a combine to harvest corn. There's no use taking these stalks in the machine, let's get the ears off and just run the ears through." And he said, "We'll do it." Just like that.

You never saw a bunch of engineers in a company that moved around the way those guys did. This was in December and we were going to harvest corn the next season. Within a month or two I had three or four engineers in my office at Davis. They came around and were thinking about it. They put a two row snapping device on a couple of combines. And they didn't know that I had also put the bead on John Deere, you see. [Laughter] And so we had two companies working on the project. They asked "Where can we get some corn to work on this summer?" See, corn doesn't

Bainer: ripen up until October or November in the corn belt. I said, "Well, I'm sure I can get you corn to work on long before that. How about July?" Oh boy, they just couldn't imagine having corn to work on in July. I said, "I can get some." So I got a hold of farm advisor Win Lawson in Riverside County and found there was 400 acres of corn in the Palo Verde Valley near Blythe and not one piece of corn harvesting equipment. And so through Lawson we made arrangements with several farmers to harvest corn. About that time Robert Curley joined the extension service in ag engineering. The Director of Extension called me one day and said "We have Curley coming in and what do you suggest that we put him on?" I said, "You loan him to us for six months and we'll get him in the field and he'll have something to extend." So Curley went down to Blythe with me. After a couple of days he got sick from the heat and had to stay inside.

When we got down there, International Harvester had shipped in two combines and two tractors. John Deere had shipped in a combine with a snapper on it. We got everything unloaded and moved out to the field. We agreed to run the tests and they would keep the machines going. And after all, there wasn't any sense in us building any equipment like that. They knew how to do it. Well, we had John Deere and International Harvester side by side in the same field. I think it's the only time I ever saw experimental machinery from two companies in the same field.

By Friday of that week it got hot! I never saw such hot weather in my life! We came in Friday night and the night clerk at the motel also kept the official weather of the valley. He said, "Do you fellows realize how hot it was today?" I said, "Well, it was the hottest day I ever spent in my life." He said, "Well, it was officially 119 degrees today." And here we were out in the cornfield pulling blankets after a machine and not a breath of air. I'm telling you, I was dehydrated. Well, these boys from Illinois --

Dickman: I bet it killed them.

Bainer: They got scared even though no one was hurt yet. Curley got sick, we had to leave him out of the picture. But I don't know whether it was heat or drinking so much strange water. Well, anyway, these fellows came around that evening and they said, "We just don't know what to do, because when we've worked on corn it's in the fall, you know." "Well," I said, "if you want my opinion we'll go out the break of day and at 12:00 we'll quit for the day. It'll be hot, but we won't have to go back into it in the afternoon."

Bainer: Then we found out that we couldn't get anything to eat that early in the morning. We were working on Dana Fischer's place out south of Blythe. I called Dana up and said, "we'd like to start at sun up and quit at 12:00 but we can't get any breakfast in town." Well, you see, I was just feeling for an invitation to breakfast. "Oh," he said, "bring them out at four in the morning and we'll have breakfast for them." He was getting his corn harvested for nothing, after all. You never saw such breakfasts as he laid out for these guys. We enjoyed it. We went out for breakfast at four in the morning and finished up at 12:00.

We harvested all 400 acres in that valley and moved up to Bakersfield. And that was the beginning of the combine in corn, right there in that little old hot valley in Blythe, California. By the time we got through -- we had visitors from all over. We had visitors from other companies that weren't supposed to be there, but you couldn't avoid it. After all you had this equipment. There wasn't anything really patentable about it because it was standard equipment. But by the next year everybody's brother had corn heads on combines. Much to my surprise, the whole movement of combines in corn went right through the Middle West, and they sell very few corn pickers now. And it all started right here because we didn't know if the farmers would ever continue to grow corn, and they haven't. I mean, when they can grow other crops they won't grow corn.

Dickman: How long did it last? How many seasons did they grow corn before --

Bainer: We're still growing corn, but not in a big way.

One other thing that I failed to mention was, of course there was a little rivalry there between these machines, and in some instances John Deere was having a little better success at the beginning. This wasn't true later on, but they apparently didn't have so many bugs to get out of the machine. After a few days, one of the engineers, and I won't say which company, came to me and wanted to know how the other guy was doing, see. I said, "You know, I'm feeding this man his information. I'm feeding you your information. If you guys want to get together at the bar and compare notes it is OK with me." Later on the tests were published (Field Tests of Combines in Corn. Agricultural Engineering, 36 (12): 794-796, Dec. 1955). It was surprising how fast this country moved in to corn combining. Everybody and their brother got into the act. There was a half-day symposium of corn harvesting at the winter meeting of ASAE in Chicago, in 1955. We had the jump on them as far as getting the field work done.

Bainer: We didn't do some of the basic lab work. Illinois has to be credited for having done some work, but that was only in the laboratory. But when they applied it, they put it on a machine where they took in the whole stalk. The idea of getting rid of the stalk was most important.

Cotton Harvesting

Dickman: This looks like a good lead to get into cotton harvesting.

Bainer: Well, actually, we got into cotton harvesting before corn harvesting. Along about the late '40s there was some interest in mechanical harvesting. A picker was sent to California by International Harvester. You see, there had been people working on cotton harvesters for 100 years, and it was beginning to reach the point where it appeared a machine was in the offing. Jim Fairbank, who had been our extension engineer for many years, felt that he'd kind of worn himself out. This travel got to him, and it looked like maybe he'd have to give it up. So rather than to lose him we invited him to join ag engineering. We decided that Jim would be a good man to take on this cotton mechanization job. So we approached him, and there was just enough travel from here and the Bakersfield and Fresno area --

Dickman: You were working Shafter then?

Bainer: No, we weren't working Shafter then. Actually we were doing this work in Fresno County, but it gave Jim, who had been used to going every week, you know, at least a little travel so his feet didn't get too itchy. [Laughter] Well, the University had been willed some land out west of Fresno, and we decided that we'd set up a cotton mechanization project in Fresno County and use, say a hundred acres of this land. So Jim wrote up the project for cotton mechanization, and how we got it approved I don't know, because there wasn't anyone in the University administration that was interested in cotton. However, we put it through and it was approved.

You see, we had people in the University at top level that thought cotton was a poor man's crop. Really, this was their attitude. I didn't realize this at the time we were getting into it. In fact, I suggested the title, that we just call it "cotton mechanization." Well, anyway we set up this project, and International Harvester Company, through their dealer Allied Equipment Co. in Fresno, furnished us with a cotton picker. They cooperated. I was probably a little too critical back in

Bainer: the legume seed harvest because we did get their cooperation on the cotton project. Each year they furnished us with a new model. This was not their general practice over the country. I was told that when other institutions wanted to do some mechanization work they went direct to International and International got around furnishing machines by saying "this is just a University-dealer relationship."

Well, anyway, we had the machine. This place we were growing cotton was miserable land, foul with weeds. They added to the problem. After a year or so it was evident that we needed a tie with plant people. So Jim and I went down and talked to George Harrison who was then superintendent of the Shafter experiment station. The Shafter station is a U.S. Department of Agriculture station. It's not a University of California station, even though people from the University sometimes work there.

George Harrison was one of the greatest cotton breeders that ever lived. And George, by this time, saw the handwriting on the wall. He knew that cotton was going to be mechanically harvested. It wasn't here yet, but it was certainly in the future, and when we came in and told him what we wanted to do, that we'd like to have him as a cooperator and to observe the machine working on different varieties. He thought this was great.

Dickman: Who was he again?

Bainer: George Harrison,a USDA cotton breeder; he had been there for years, and was doing some breeding work, you see, trying to improve cotton. And so we moved everything to Shafter, and it was one of the greatest moves we ever made. George had many new varieties coming along. He immediately reached the conclusion that everyone of those new varieties had to be picked by machine, and he wanted to see them picked. Those that didn't respond to machine picking were thrown out. So, to make a long story short, cotton mechanization came along awful fast. In a matter of -- well, let me back up.

By the third or fourth year of this project we had about, oh, 75 cotton pickers in the state. And the ag economics people decided to make an economical analysis of cotton mechanization in California. Ted Hedges of ag economics and Warren Bailey of USDA led this study (UC Bulletin 743 - Economics of Mechanical Cotton Harvesting), it included 63 machines. As I recall hand picking was costing around three or four dollars a hundred. At that price machine picking was competitive. After charging off

Bainer: machine costs that included interest, amortization, repairs, labor, loss on yield and grade, the saving was $20 per bale over hand picking. This was a beautiful study, and you immediately got the reaction of farmers.

Dickman: How much could you make per bale picking by hand?

Bainer; Hand picking cost at that time was $45 per bale vs $25 per bale for machine picking. This saved $20 a bale.

Dickman: I see, and it paid for the mechanization completely?

Bainer: Yes. Of course, as mentioned before, field losses were higher and the quality of the cotton was lower than for hand picking. Yet the saving was attractive. Furthermore, the problems of maintaining a hand crew were great. The machine was ready to go on Monday morning and sometimes the picking crew did not show up. The mechanical cotton picker took over, there was no question about it.

Dickman: About a hundred percent now, isn't it?

Bainer: Yes, pretty close. I'd say ninety-five percent. And we had six thousand machines in this state in just a matter of a few years. For a while, Allied Equipment Co., Fresno, did a three million dollar a year business. Well, anyway, this cotton deal really went over and by the time we got through there were four different commercial cotton pickers, John Deere, International Harvester, Allis Chalmers and Ben Pearson. Allis Chalmers and Pearson incorporated principles developed by the Rust Brothers.

Dickman: Did cotton mechanization hit the South after this?

Bainer: Yes.

Dickman: All over the country?

Bainer: Of course, it hit simultaneously, to an extent. But there never was anyplace where they really got off the ground as fast as they did in California. And of course, our yields were high and the project really moved. We had a pretty good control in California because we had a one variety law, and that meant that -- the Cotton Council, or whatever you call it -- the regulating body in California was using varieties that came out of Shafter. And this cotton was standard except in the Imperial Valley.

When we were working with George Harrison at Shafter, he made some studies involving cotton population -- percent population

Bainer: per acre. He had plantings that were spaced two, four, six, eight, ten, twelve, fourteen, sixteen inches apart in the row. And you had to get clear up to around twelve or fourteen inches before you could show any difference in the yield. Apparently old Mother Nature can only set so many boles per hundred feet of row depending pretty much on the fertility level and the moisture level. This was a great result, because it reduced the necessity for doing so much blocking and thinning of cotton. In other words from these tests it was evident that plant population in the range of twenty thousand to eighty thousand plants per acre gave about the same yield. So that we began to think in terms of planting cotton to stand. And this was made possible through the use of acid to clean the seed. The seed from the cotton gin has a little fuzzy coat. The gin just can't take off every piece of fiber off of that seed and if you tried to plant this fuzzy seed one seed at a time it's just impossible because the seeds cling to each other. By putting this seed into sulphuric acid bath, the acid ate the cotton off the seed and gave you a little brown seed that had no fiber on it whatever. There is no damage to the seed. In fact, I think it cleans the seed up of organisms that might be on the seed. And sulphuric acid, of course can be dumped in the irrigation water and used as a fertilizer.

The move to Shafter was a very, very important one in furthering the mechanization program. One of the things that Harrison had been doing for years was to breed a cotton that set it's boles closer to the ground, figuring that the closer they were to the roots the better off he was. Then he saw the machine in the field with the lowest spindles working close to the soil and picking up dirt. He started a project in which he wanted to do the reverse, that is, raise the heights of the boles. One of the things that came out of close spacing was an actual setting of boles higher on the plant. And so this was an advantage.

Another thing that came out of the Shafter studies was the use of flame for weeding. After the cotton plant gets about the size of a lead pencil it can withstand a tremendous amount of heat. The little succulent weeds that are growing in the row are easily knocked down with flame. And they had instances where the cotton was flamed as many as eight and nine times in a year combined with a cultivation of the space between the rows without a reduction in yield. Now there's been a new angle introduced in that (and this wasn't in California, this was in the South, I think at Stoneville, Mississippi) they introduced a little spray of water that was above the flame and was directed toward the base of the flame, and this little water spray hit

Bainer: the plants above the flame and kept them cool. So that flaming has really had a rebirth -- a rejuvenation.

Now, one of the things that's somewhat related to the cotton. Along about 1951 or '52, I was invited to go to the International Harvester Company for a three weeks seminar. They had invited twelve or thirteen professors from institutions across the country, and believe it or not I was the only agricultural engineer invited. They invited a couple of mechanical engineers, an economist, a journalist, other people, but all professors, and they called it the Professors Seminar. And, they held this every year on an invitational basis.

When we arrived in Chicago we were told by the president of International Harvester Company, Mr. McCaffrey,that we could ask any question that we wanted and expect to get a reliable answer. We could see anything we wanted to see, visit any plant that they had in the United States. It was a real wonderful experience. And the first week and a half of the period was an organized sort of a seminar in which vice presidents of the various divisions were asked to put on a program telling of their particular division in the company.

Well, when I was in Mr. McCaffrey's office, one of the questions that I was interested in was "How many man hours goes into the manufacture of a cotton picker?" I think I was interested primarily because we had just entered this cotton mechanization program. While we were displacing a lot of labor in the field, I wanted to get some idea on how much labor actually went into the construction of the machine. Mr. McCaffrey agreed with me that he'd like to know, also. And so he told me to ask this question of each of the vice presidents as we were in session with them, and he said "Someplace along the line you'll probably get an answer. And when you get one, I want to know what it is."

Well, they apparently never thought about this phase. So I made rather a nuisance of myself. I kept asking the question of how many man hours were actually used in building a two-row cotton picker. Well, no one had the answer, and the next thing I knew, they put a man on it to study and come up with the figure. I began to think I wasn't going to get an answer to my question. About two or three days before the end of the three week seminar, I had a telephone call to come to a certain room in the International Harvester building, that a man wanted to talk to me. It was the man that they had detailed to find out how many man hours went into the production of a two-row cotton picker. And he was surprised. Now, this man had never thought of it, you see, in this particular frame, and he said, "You know, this has

Bainer: been a terrifically interesting experience for me to delve into this thing and come up with the number of man hours that go into the construction of one of these machines. And the interesting thing is that practically every bit of the cost of that machine is man hours." He said, "The only thing that I can attribute other cost to is a royalty to the landowner where iron ore and petroleum or coal are mined. Also the rent that you'd pay for a building in which you are doing business. But, you know, practically the entire cost of that picker is man hours. When you trace it from the mine through the smelter through the manufacturing process and all the engineering, and then the transportation out to the farm, the dealer who pays some rent on his store, but mainly man hours, again, and finally go over to the operator, and of course the operator puts more man hours into it and his fuel represents man hours. His repairs represent man hours. His labor on the machine represents man hours." And when he got through the figure was seventy-five hundred man hours put into the production of one of these two-row cotton pickers. At that time, a man hour cost more than $2.00 (its much higher now). So there was fifteen thousand dollars in man hours invested into that picker. The farmer bought seventy-five hundred man hours when he purchased a machine. And so, as he used that picker he had this amount at the start. And of course, this was rather insignificant probably in comparison with what he would eventually pay for hand picking. But, nevertheless, people just don't think of a machine representing man hours.

One of the other things that a former president (Fowler McCormick) of International Harvester Company was concerned about the company going into the cotton picker business was the tremendous displacement of labor. He was a little more socially inclined. I mean, he was worried. So, he decided that they would make this cotton picker at Memphis, Tennessee, and that they would hire local labor, some of which would be displaced in the cotton fields. That there would be no discrimination whatever in this labor, whether they were black or white. And apparently he had quite a run in with the city dads of Memphis, Tennessee when he said, "We'll have no lines in the cafeteria. We'll have no separate toilets for the blacks or the whites. We're going to treat everybody exactly alike on this job." This was one of the first, really, honest to goodness attempts to integrate the whole operation. And, they finally went along with him. And, this was one of the first big plants that was completely integrated as far as the blacks and the whites were concerned.

Another very interesting thing happened in this Shafter deal. After we were getting along and had the four machines in the

Bainer: fields, and the comparative studies were of interest to everybody in the cotton area, we held a field day at Shafter. We could never get the proper administration officers down to these field days. I knew this was going to be one of our outstanding field days. I went to Dean Hutchison, vice president for agriculture, and I told him we were going to have this demonstration at Shafter on the certain day. I said, "I'm expecting you to be there." And he said, "Well, I'd like to come." I said, "I'll make arrangements for you to come down on the six o'clock Santa Fe out of Berkeley that gets into Bakersfield at 11:55 p.m. I'll meet you at Bakersfield Station and I'll have a room for you at the hotel and I'll take you out to Shafter. And, I'd like to have Paul Sharp (the director of the experiment stations) come along." He said, "We'll come." I said, "Now, we've got a little difficulty in getting you back, because we can't get you back in Bakersfield in time to catch that Santa Fe that comes back in the evening, but I went to the Santa Fe Railroad, and I'm having that train stopped at Shafter. It's never been stopped at Shafter, but they're going to stop it at Shafter for you fellows." And I'll never forget. I went over to the station -- and it was one of those streamliners. Santa Fe used to run those streamliners down in the valley. And they were fast! The old conductor got off of this train and he said, "Now I've seen everything." He said, "I never thought we would ever make a stop here." And these three or four executives got on the train to return to Berkeley. I got such a kick, because as I told you earlier, we got into this cotton mechanization in a way that just wasn't quite orthodox because the top administration at the University was not sympathetic about work in cotton which was supposedly a poor man's crop. But after the demonstration Hutchison came to me right there in the field and said, "Now, listen, Roy, any time you roll out a show like this, I want to be there." And you know, it did more to boost the morale of the cotton people in their relationship to the University. Many of them were alumni, and here was the top brass down there shaking hands with them in kind of an old home week. But, that was one of the times that I went overboard.

Dickman: Let me ask you this: This man hour matter had a good deal of significance to you. As you related the number of man hours and compared it with the number of man hours displaced, can you elaborate on that a little bit?

Bainer: Of course the situation is, if a man really kept his machine up and was careful and operated it properly, why he would use seventy-five hundred man hours shortly because one of these two-row machines took the place of forty men in the field. In other words, a one-man machine is doing the work of forty. I never did

Bainer: quite carry it out just how far you'd have to go, but it wouldn't be too far down the line until you'd add up that many man hours.

Dickman: But your thought is that there was some balance on the other side?

Bainer: Yes, that's right. It wasn't all just a one-way street. And, when you consider that the farmer was paying for a very high-priced labor. You see, all the labor that went into this machine, in the manufacture, transportation and sales, the whole works was much higher in price than the man in the field.

Dickman: If you say twice as expensive labor, you can say that he's got fifteen thousand man hours, maybe, to balance out.

Bainer: That's right.

Dickman: Have they ever tried the use of sulphuric acid bath on seeds other than cotton?

Bainer: No.

Dickman: What would it have done to sugar beet ?

Bainer: No, you see, the cotton is very susceptible to acid, as you know. I don't know whether you're familiar, but the man who works in a storage battery shop, where he might spill a little of that acid on his cotton pants (that's the kind of acid that you use in a battery -- sulphuric acid), they are gone. But wool will withstand the acid.

Dickman: I'd like to explore something with you. You said that the mechanization of cotton took off in California like a bolt out of the blue, and much faster than anywhere else. This was true in part of the mechanization of other crops in California, and would you say why it was true?

Bainer: Well, I think it's because of the level of the intelligence of the farmer of California. I don't suppose we have any other state in the union that has so many university graduates on farms as in California. So you're dealing with an entirely different group of people than you are in many other sections of the country. I'll just tell you one incident. During the Depression there was a group of farmers in the Clarksburg area about 25 miles southeast of Davis. And, this group of farmers was growing asparagus, and there was little demand for processed asparagus. In other words, during the Depression there was a

Bainer: cut back and asparagus was kind of a luxury item in the grocery store and people weren't buying it -- I'm talking about canned asparagus. And so this group of farmers, and there were thirteen of them -- decided they would lease a little canning plant that was shut down for the season and do their own canning and marketing. They had this asparagus and they just hated to see it go to waste and they would just give it a try and see if they could come out on it. Professor Walker went to a meeting of the organization of this group at Clarksburg, and couldn't get over the level of the intelligence of this group. He said, "You just won't believe it, but I got interested in this just as a sideline if all these fellows went to college. Of the thirteen, seven of them were graduates of the University of California and six of them were graduates of Stanford." This is an exception, but you're dealing with people who are more businesslike in their farming. It's more of a business to them, and they're looking for ways to cut corners. It's just like Bernell Harlan in the sugar beet story. He saw a chance to save some money. These people are alert. I think it's just the high level type of farmer that we have that makes the difference.

Dickman: What about other factors, too. Let's say, how about the control of weather?

Bainer: Oh yes. That's very important. The fact that we can grow cotton in this state and never have it rained on contributed to high quality. Of course, our costs of operation are higher in California because of the high price of irrigation and the high price of land, and we're a long way from the markets. There are just a lot of factors that all add up to make it much more hazardous, we'll say, for a man to farm in California than in Kansas, for example.

Dickman: Which makes it all the more important to be mechanized and to farm economically in a sound way.

Bainer: That's right, he's got to cut every corner. There are still a lot of farmers on the ragged edge. I think we're facing another very serious period in agriculture in California in that costs have gone up and up and the prices of the product the farmer grows haven't gone up proportionately. And unless the squeeze is reduced, the farmer will be in trouble.

Grape Harvesting

Dickman: I'd like to ask you about grape harvesting. Has there been much mechanical harvesting equipment?

Bainer: Well, we're just getting into grape harvesting. The first was the result of work that Dr. A. J. Winkler, that used to be head of viticulture and enology and is now retired, had done. We didn't even know that he had been doing work on the retrellising of vines to prepare them for mechanical harvesting. Dr. Winkler had put up some inverted L-shaped trellises. The stem of the L was vertical and the foot of the L was inverted. It might have been a T-shaped trellis. In fact eventually he did go to a T-shaped trellis. Wires were attached to the inverted member. The vines were trained on the wires. As the grapes developed they hung down below the wires in the clear. He asked us if we'd like to go out and take a look at some work he'd been doing.

We had a young man on the staff at the time by the name of Lloyd Lamouria. He was a graduate of Iowa State College who I brought out here about 1950. And so Lloyd and I went out to take a look and Winkler showed us the experimental trellising that he'd been doing. He said, "Now, if grapes were trellised like this, do you think you fellows could take them off?" And my reaction was that it was just an upside down mowing job, just simply to go in there and cut everything below the training wires. You see, it was wires that held the vines and the grape clusters hung down. It was just a matter of going in and mowing off those clusters.

It was soon noticed that all of the grape clusters didn't develop below the wires. In some instances you'd cut through the middle of one.

The second approach was that Harold Olmo started a breeding program to lengthen the stems on grapes so they would hang below the wires. Lloyd Lamouria started a project in which he built a machine that would do this upside down mowing job. And this looked very promising, it really did. But it did mean that you were going to have to retrellis all the vineyards in the state. And we figure that it would only be of value in the wine and in the raisin industry. We didn't think we could harvest table grapes. But this was insignificant compared to the tremendous amount of grapes that go into wine and raisins.

Well, there was some experimental retrellising done in several locations in the state which gave us field trials located throughout the state, mainly in the San Joaquin Valley. There was one company that put in quite an extensive planting of grapes. Instead of being on the inverted L they were on a T-shaped trellis so that you could go down both sides. They never did buy the harvester to go with it. We ran these experiments for two or three years. The machine that mowed the grapes also laid down

Bainer: a continuous paper tray (wrapping paper) between the rows to receive the grapes and allow them to dry into raisins. Raisins are made in the field. There was a lot of art in getting that paper to lay there and keeping the wind from whipping it around and also chopping the paper off at the end of the row.

And then there was a farmer at Fresno, John Stanley, who was a graduate of Davis, who had a vineyard at the time. He had never worked on a grape harvester, but he'd worked on a continuous paper tray and a machine to pick up and turn the raisins, and then when they're dried to pick up the paper and take the raisins off it in the fields. So here was a machine that picked the raisins up once they were dried. As I mentioned, this approach never reached success because, I think, of the costs of re-trellising. At the same time that we're working on this method of harvesting, Cornell University was working on another method which had a star wheel sort of arrangement that ran in the grape vines and vibrated the grapes off. They were using it for Concord grapes, for juice. And it was showing some success. We hired a young man by the name of Henry Studer, who took his Ph.D. at Cornell and worked with some of this grape harvesting machinery. He came out here because we had let this project lapse because Lamouria left us and went with industry and now is at San Luis Obispo. Well, Studer came on the scene and we began to look at this project all over again.

Dickman: Did you hire Studer for that reason?

Bainer: Well yes. This was one of the things he was to do, to reactivate grape harvesting. Studer then came up with an impacter. The grapes were trained on wires as they are in the vineyards, but the wires were not offset, they were in the row. The vines were tied to the wires during the pruning process so that the grapes were produced on vines tied to the wire. The idea of the impacter was that you'd strike the wire, give it a quick blow which would set up a vibration along the wire, and that would be sufficient to break the connection between the grape cluster and the vine. This worked pretty well.

Anyway this impact device was built into the machine, and it would strike the wire as the machine moved down the row. This would set up a vibration sufficient to shake the grape clusters from the vine. This idea is now being developed by one manufacturer in California, and one or two in the East. There were a few grape harvesters in the field last year. They harvest raisin grapes and lay them on a continuous tray, or wine grapes that are elevated into a gondola. And it looks like these two types of grapes can be harvested mechanically.

Dickman: Are the raisin grapes raised in the same part of the country as the wine grapes?

Bainer: Yes, well the best wine grapes are grown in the coastal valleys. The Napa Valley is noted for its superior wine quality. But there's a tremendous amount of wine made down in the San Joaquin Valley. A lot of that wine is made out of raisin type grapes. The Thompson seedless goes into wine as well as into raisins.

Dickman: How long does it take a raisin type grape to become a raisin?

Bainer: It takes three or four weeks. It depends on the temperatures and the humidity.

Dickman: And they let it lay on the paper all that time? No bird problems?

Bainer: Yes, I suppose there are but they're not insurmountable, apparently. Once they've started to dry they're less attractive.

Dickman: They have to turn them?

Bainer: Yes, they have been. In the old system raisins were made on paper squares that were turned by hand. There are turners now that can pick up a paper tray and flip the raisins and put them back on the paper. They're not turned to the same extent that you'd turn the old square paper trays that we used, but sufficient to dry.

The Wine Institute, of course, would like to see the grapes crushed in the field and deliver only juice to the winery.

Dickman: What is color releasing with the wine grapes?

Bainer: This was part of this CREA project in which Jack Coffelt was working with Dr. Berg in enology. They were working on a process, you might say, or complete series of processes that might help in the mechanization of wine making, and the color release was simply a flash heat treatment that broke the color cells in the skins so that when the grapes were crushed the color would be released. Normally the color of the red wines is obtained by fermenting the grapes on the skins. You do not get the color if you merely crush a red grape. It's a rather risky business to heat these grapes with super heated steam. After several trials I've been told by Dr. Berg that this just isn't feasible even though they know how to release the color.

Berry Harvesting

Dickman: How about berry harvesting? Any mechanical harvesting?

Bainer: Well, in the last four or five years there's been quite an active program on the boysenberry harvesting. Of course this type of machine could be used on other bush berries, but the boysenberry is a very luscious fruit that's become too expensive to harvest, and as a result we're losing the market for boysenberry.

Paul Chen, another young man that was hired in agricultural engineering about five or six years ago has worked on the project of berry harvesting. And again this is a case of a machine that vibrates the bush. It was a whole series of vibrating fingers that can be thrust into the row. You can control somewhat the vibration so that the ripe berries come off but the green berries are not affected. And you can come back the second time, you see, and pick the berries that were immature during the first picking. Well, the machine is quite a machine. It's really sophisticated and it looks like a monster, actually. It can be made to straddle a row with the tines coming in from each side. Shen has been working with food technology on this problem. They have incorporated a quick freeze so that these berries are not only harvested by the machine, but in twenty seconds they're frozen and delivered in a frozen state. This is a great factor in maintaining the quality. But by being able to shake them off and freeze them in this short period and then clean them up after they're frozen, seems to offer quite a lot of promise. We haven't done anything commercially with this machine. It's still in a prototype stage, but it looks quite promising.

Soil Compaction Work

Dickman: Have you been involved in soil compaction work?

Bainer: The soil compaction work was started when I was chairman of the department, and I, of course, kept fairly close tab on it. I hired Dr. Chancellor, a young man just finishing his doctoral work at Cornell University, to come here specifically to work on soil compaction. The soils people brought in a young soil scientist by the name of James Vomocil. Vomocil and Chancellor then made the team between ag engineering and soils. And, of course, other people became involved -- mainly in the water science and agronomy because soil compaction was a factor in producing crops.

Bainer: Soil compaction seems to me to be an increasingly important problem. I think primarily because the size of the power units used on the farms is getting larger and heavier. The weight of the machine and vibrations from the engine are transmitted to the soil, and under certain moisture conditions, compacts it. A point is reached where you can't get water penetration or even root penetration. I have seen pictures taken by the water science people in the Bakersfield area, where the roots of cotton plants reached a compacted area as much as 12, 15, 18 inches deep, and were actually not able to penetrate any further. They simply make a turn and grow horizontally. Well, anyway, this team started out and we brought in a German scientist by the name of Walter Soehne for six months as a consultant to this group. Soehne had a great reputation at Braunsweig in Germany, and was a very productive individual. We then had some graduate students working on the problem.

Well, they tried to produce soil compaction in soil bins in the laboratory which is pretty hard to do in a way, because of border effects. About that time, certain people in extension became interested in soil compaction and set up field experiments. One of the things that naturally comes to mind right away is, "Well, soil compaction is there. Let's chisel through it and break it up -- make channels through it to let water and roots through." Well, this works for a short period of time. However, after a heavy application or two of irrigation water the soil runs back together and the effect of the chisel is lost. A more lasting effect resulted when the slot cut by the chisel was filled with chopped straw, rice hulls, etc.

The soil scientists tell you that the more you keep off this soil, the less compaction you're going to have. And so, there has been a concerted effort to reduce tillage operations. In some cases, chemical weed control has been used instead of cultivation.

Some very early work was done by Collin Taylor, stationed by the USDA in Southern California. In his studies of water penetration in citrus he used a system of permanent furrows placed 28 inches apart between tree rows. The water penetration in the furrows next to the trees, where there had been no traffic, was about four times greater than in the furrows out in the middle where tractors had been running. By limiting all traffic (tractors, spray rigs, dusters, picking wagons) through the orchard to two designated furrows, 56 inches apart, he was able to correct the compaction problem.

I think that we're going to be faced with soil compaction as long as we're using heavy equipment. I've often wondered why

Bainer: soil compacts 16 to 18 inches below the surface when most tillage operations are done in the top six inches. It's, no doubt, due to excessive weight and vibrations. Possibly a turbine in place of a piston engine might cause less vertical vibration. But I am concerned about the increasing size of tractors and the weight of equipment. And, of course the soils and irrigation people tell me that part of the problem is working land when it's too wet.

Seeds and Planting

Dickman: Is there a great improvement in planters now?

Bainer: Yes, I think so. I know that certainly in the sugar beet work that the smooth tube planter was a great improvement over the spiral ribbon tube and then of course, there's a lot of other approaches. There's been vacuum type planters that have been developed. They actually have a planter that uses air pressure to load the cells and unload them and get the seeds at the right place. There's processing of seeds to make them more uniform to plant. There's coating of seeds. You can buy flower seeds now in a coat so they're easier to handle.

Dickman: Is this what they call pelleting?

Bainer: Yes, pelleting. Dr. Chancellor and his graduate students have shown a renewed interest in planting. They've gone into more precise metering, and the possibility of metering into a tape. Of course, it would have to be a water soluble tape, which would carry the seeds uniformly spaced and these tapes would be loaded in a laboratory, and of course you'd put them in the field pretty fast, lay the tape.

Dickman: Are these economically feasible?

Bainer: They might be in certain crops. I think pelleting seeds is certainly feasible in certain crops. One of the problems, of course, is getting pellet material in there that will soften up with moisture. This was the problem in some of the earlier pelleting. More and more pelleting is being done, and I know that they're still working with the possibility of pelleting. They have pelleted mono germ sugar beet seed which has an odd shape more of the wafer nature, and with a certain amount of roughness which makes it difficult to plant in a uniform manner. And we're finding that absolute uniformity in spacing of plants isn't as important as we used to think it was. It's important in a crop like lettuce, because you've got to have room for head

Bainer: development. But when it comes to sugar beets or cotton or corn, they're more interested in the number of plants in a hundred feet of row rather than the actually, individual spacing of the plant, as long as you don't have long skips.

The variation in yields as related to the spacing leads one to believe that we can stand a lot more variation than we had thought possible before. But in general, planters have been improved,there's no question about it. They've been made in a more precise manner, and they've improved dropping seeds to get them uniformly spaced in the field. They always have a horizontal component -- the velocity of the machine tends to roll the seed after it hits the ground.

One of the things that I observed early in the sugar beet work when we were working with planters, I wanted to determine uniformity in which these plants actually came through the ground surface. I used some real large seed balls which ran as high as five germs per seed ball, and we used a plate that would hold only one seed ball per cell. We used the smooth tube to put the seed in the ground. We were spacing seeds at three inch intervals. Skips of 25 ft were left so they could be planted at the same intervals by hand. The variables in the soil threw you off a half inch plus or minus from where you planted that seed. So, I discredited the necessity of doing a great deal of work on planters if this is what you were going to run into in the field. It was ridiculous. I felt we had over designed or over developed planters. We'd germinate beet seed in the green house, and get a potential germination, in some instances, 80 or 90 percent. Then under field conditions under a range of moistures, the field emergence as compared to the greenhouse emergence might be -- oh, if you got 35 or 40 percent that was pretty good. Well, what are you going to do? Why all this precision when germination under field conditions is so low. There are a lot of factors here that can lead you astray once in a while, towards perfection, when the variables of germination and the variables of the openings through which the plants come can just throw you completely off.

BRIEF HISTORY OF THE MECHANIZATION OF AGRICULTURE IN CALIFORNIA

Dickman: I understand that the mechanization of agriculture in the United States, particularly in California, and more particularly during the last forty years, is unique in the world's history. Would you discuss this, please?

Bainer: Well actually, some of the basics related to the mechanization of the last forty or fifty years actually started more than one hundred years ago. There was a long, long period before there was general acceptance of many of these ideas. I think the most important invention, as far as agricultural equipment is concerned, was the combine harvester. According to the records, the first combine was patented by Hiram Moore of Climax, Michigan in 1836. This was only five years after McCormick introduced his reaper, and to go from a reaper which simply cut the grain and gathered it, to a machine that cut the grain, threshed it and separated the grain from the straw five years later was most significant. And yet the reaper was used for many, many years, and the combine never got into use for many years. It was transported from Michigan to California via Cape Horn in 1853 and used in 1854 to harvest 600 acres of wheat near Mission San Jose. Then, of course, on the west coast, the combine came along rather rapidly. If you go back to Michigan, the first introduction of the combine was in the late twenties, and it was really mid-thirties before it was really accepted. This was a hundred years after its invention. It took twenty, thirty, or forty horses or mules to pull the machine. The power for operating the machine was taken from a large ground wheel.

Dickman: Now, traditionally California has always been more interested in mechanization?

Bainer: That's right, and then when it came to putting combine in the rice, California was where it happened. The same thing was true of corn. And you can just go down any number of instances like this. We were first in a lot of things. Take hydraulic controls for machinery. For many, many years we had mechanical lifts on plows where the operator had to furnish the man-power to lift the equipment. Well, the first hydraulic controls came out of California. I remember serving on the standards committee of the American Society of Agricultural Engineers for standardizing hydraulic controls so that each company that built a tractor with a hydraulic pump to lift plows, for example, could meet certain standards without having to make everything exactly the same. And so we set up two standards: one for power units up to 35

Bainer: horsepower, and another for 35 horsepower up. And rather than to say the pump had to be a certain size, at certain pressures, and so forth, we said the job had to be done in a certain length of time. And you could do this in many ways. You could have a higher pressure and a lower volume and still do the job in a certain number of seconds. And we also boxed in an area that everybody's hydraulic equipment had to fit. It meant that a hydraulic pump on a John Deere tractor could be hooked up to a hydraulic control on a piece of International Harvester equipment. We wanted this flexibility. It took quite a little bit of planning, but it came out all right. We had to standardize hose fittings. Well, this all started in California. And, look what happened in tomato harvesting. The first pick up balers and bale loaders were in California. The first tree shaking. I mean, you just go down the pike and California was in there in the lead and that's one thing that's enticing to a man in my position because there was more opportunity in California for an ag engineer than in any other state in the union.

Dickman: You could see that back in 1929?

Bainer: Yes, I could, and that's one of the reasons I came to California. They were doing more work at Davis in ag engineering certainly than we were doing in Kansas. And, you see, when you have more than two hundred commercial crops, everyone of them having an engineering problem -- all the early work on pest controls, sprays, spraying machinery, dusting machinery. You go down and you name it and it was pioneered out here.

Dickman: So you might say truthfully that an ag engineer at Davis over a period of years is probably exposed to more crops and has more experience with more diverse crops than anywhere else in the United States?

Bainer: That's right. There wasn't any period of world agriculture mechanization that compares with the last fifty years in California. It's quite unlikely that you'll ever have this situation again.

Dickman: Why don't you think it will continue at this pace?

Bainer: Because -- well, you know, back a few years ago Dr. E. G. McKibben, who used to be at Davis, and the man -- I took his job when he left --

Dickman: He collaborated with you on your textbook.

Bainer: On the tractor book, yes. Well, anyway, Dr. McKibben wrote an article (The Evolution of Farm Implements and Machines-Agr. Eng., 34:91-93 Feb. 1953) trying to explain why the United States had this phenomenal experience in mechanization, and he indicated that we went through a period which was unique in world history. A period that probably would not ever exist again anywhere, and he gave about 26 elements as to why this happened. Included are such factors as a stable and equitable government, our system of free enterprise, a rapidly increasing population occupying new lands, a surplus of clear, level land well suited to mechanization, a shortage or infrequent surplus of agricultural labor, a rapidly expanding and effective industrial development, and a remarkable development of transportation facilities. The development of efficient tractors to replace horses and mules as farm power units has greatly broadened the horizon for mechanical agriculture. In my opinion, Dr. McKibben omitted one important factor. It was the development of the land-grant college system.

Dickman: In other words, what you're saying is there was actually a shortage of labor, not a surplus of labor?

Bainer: That's right. There was a shortage of labor most of the time. Now, we had a short period when there wasn't, like the Depression Years. And we had an area like the deep South where there wasn't a shortage, but we did have in general a shortage of labor. We just had a group of people that wanted to be their own bosses. Of course I think that labor is not exactly short, but we'll say labor is going to be unwilling to do many of the things that we need to do on the farm when it comes to certain crops. I feel that if the crop can't be mechanized we're probably not going to be able to produce it. If we do, it's going to cost more. There are some crops, such as strawberries, that will be harder to mechanize. I'm not saying it can't be done [Laughter], because I've seen too many things done that I thought would be a long time off. But they come pretty rapidly when you reach a showdown. There are more effective manufacturing methods for making implements such as automatic precision tools. Not too long ago I visited a factory where they made combines in which the parts of the straw rack, for example, were fed into a machine where they were automatically welded and came out all assembled as a straw rack ready to put into the combine.

And there have been lower cost methods developed for producing steel and other metals. Of course, during this evolutionary period the internal combustion engine entered the picture. Gas and electric arc welding came in with a lot of improvements that carry right over into the farm shop for maintenance of

Bainer: this equipment. The evolution of the internal combustion engine and development of fuels and lubricants to go along with it has been a boon to agriculture. Whether or not we can rely upon this form of power remains to be seen because there will have to be some changes due to pollution that's produced by these engines and fuel shortages. And then of course another thing has been the utilization of electric power in the rural areas. Anti-friction bearings came into the picture, as well as enclosed transmissions and effective seals. The evolution of the airplane which I'm told now covers seven or eight million acres in California each year. And so you just start to put all these things together, hydraulic controls, the advances in the biologic sciences and the contribution that the plant breeder is able to make to aid the mechanization of certain crops which we've already covered to a certain extent. The improved processing plants, and any number of things you could cite that have been more or less responsible for this great evolution that the United States has gone through. I think this is the background that you need when you begin talking about some of the other factors that come as a result of displacement or substitution for labor.

There isn't any other country in the world that has the high standard of living that we enjoy in the United States. And I would say a lot of it hinges on the mechanization of agriculture. You go back in our history and find that in the early 1800s, ninety percent of all the people in the United States lived on farms and depended upon agriculture for their livelihood and they produced very little surplus of products. And then with the evolution of the machinery -- the evolution we just talked about, the number of farmers has decreased and decreased, until now approximately five percent of the working population is actually engaged in agriculture and they're able to feed the other ninety-five percent and have a surplus for export. This is a terrific change. I'm surprised that we haven't been in more difficulties than we have in keeping people busy. But as McKibben pointed out and I think I pointed out before, there have been pressure periods in which labor was really short due to manufacturing and especially when the country was at war, and you're building war material as well as drafting men into the services. So we've had these pressure periods which I'll say have accelerated the application of mechanization to agricultural production. Nevertheless there has been this tremendous change in the evolution of people leaving the farm for industry and other pursuits, and in the course of development. While manufacturing has absorbed many, many of these people, there are other service areas that have really grown, and as the result have employed countless numbers of other people that

Bainer: would have otherwise been engaged in agriculture, and when I think about this -- think of everybody from the barber to the plumber to the electrician, to the people engaged in vacation enterprises, the people that serve as gardeners, landscapers, architects, when you think of the many, many people that are serving the rest of the nation -- beauty parlor operators, garage mechanics, it's just absorbed or committed say to the development of the service agencies that couldn't have developed unless there were people to do it. This has given a kind of an independence away from just being a cog in a machine. I mean he's an enterprising individual who wants to serve the rest of mankind, and he does it by developing some service. These services have raised our standard of living, certainly.

Dickman: And these people would have been needed on the farms as workers.

Bainer: That's right, that's right. Well, we are moving quickly to shorter and shorter weeks. There was a time when people had to work a lot more hours. Everybody's grandfather talks about the twelve and fifteen hour day they put in. I found it was pretty hard when I was on a farm to get in fifteen hours when you come right down to it. I would have liked to have argued with him a little bit afterwards, but I tried it a few times especially in harvest. The situation is that we've gone from a seven day week now to a five day week and we're approaching a four day week, and we've gone from twelve hours a day six days a week to eight hours a day five days a week, and I just think we're going to continue to move in that direction, and as a result there will be more people needed to provide the recreation facilities and learning facilities that some people will want to take advantage of. Whatever will keep people occupied. You just can't live much easier than how people live in the United States when you come right down to it. And it all goes back to the mechanization. So the situation is that you developed rather rapidly, and when you consider that industry plus a couple of wars (World War I and World War II) just stripped the farm of labor. You can say all you want to now in criticism of the agricultural engineer -- he's now getting blamed for -- and maybe rightfully so for the ghettos and unemployment and the like -- but the point is they were pretty proud of this agricultural engineer during certain periods of our history in being able to take a small group of people and still be able to feed the people and the armies, and replace those people going into industry.

Dickman: And World War I and World War II both, we fed a lot of the world.

Bainer: That's right. There's no question about it, and we still have a surplus. Certain things happen. If you go back in history

Bainer: you'll find that even the Civil War had an effect. During and following the Civil War, I would say, there was an acceleration in the use of machinery like the combine, binder, and the stationary thresher, and steam. When you got into World War I, there was a great stimulus to convert from horsepower to mechanical power. And that, also, along with the tractor which came in during World War I. At the close of this war changes began to get interesting, the combine harvester in the rest of the United States, for example, use of the combine harvester was old in California, but in the rest of the United States the combine harvester came in along with the tractor.

During and following World War II, came sugar beet and cotton mechanization and the beginning of tree crop mechanization. Other uses for the combine harvester, which came in and were accelerated just due to the fact that you just didn't have the labor to do the job. Now, it's a different story. People forget, but I'll tell you there were some very important contributions from the ag engineer to the slogan -- "food won the war."

Effects of Mechanization on Labor

Bainer: This whole matter of substitution of machinery for labor, especially stoop labor, I've never felt bad about being a part of it because man was more or less created in the image of God and he shouldn't have to make his living through drudgery. If there is anything more drudging than harvesting a crop like sugar beets, I want to know about it.

Dickman: Well, you had experience on your own.

Bainer: Yes. When we were working on sugar beet machinery, every once in a while we'd have to go off the university property to find some sugar beets. South of town on Becker's ranch there were sugar beets being harvested by hand. We asked Carl Becker if we could try our machinery in his field. We assured him that the beets that were harvested would be picked up. He said, "Well, I'll have to talk to my laborers." And the laborers didn't say we couldn't come, but they weren't very enthusiastic about it. Well, we went out and we harvested a few sugar beets, about five tons -- I remember we got a five ton load.

The laborers had contracted to harvest the field, and anything that we did, of course, they got paid for, because that was part of the deal -- he paid for every beet that came out of the field. And do you think the laborers would pick up the beets after we

Bainer: had topped them and put them on top of the ground? To get anybody from the campus to go was rather difficult. We had one student that worked for us part time. I told him that he and I were going to have to go out there and pick up those sugar beets. There was just no one else to do it, and we couldn't leave them in the field. So we went out and picked up five tons of sugar beets, and I want to tell you, by the end of the day I was dragging. And it made me see more clearly that this shouldn't be a job that anyone should have to do. So, from the drudgery angle I've always felt that mechanization was well justified.

Here about three years ago, there was quite a sympathetic group of students on the campus who wanted to do something for the people being organized by Cesar Chavez at Delano but really didn't know how to do it. They were very critical of the University for its contributions toward mechanization, and there were people who actually wanted to shut the University down and stop all reasearch -- I mean students. They weren't thinking very broadly. It was just a reaction -- shut the place down. So, one day, at the height of this unrest, Chancellor Mrak called me. I was still active as Dean of Engineering. He warned me that there would be a group of students come over and picket engineering that afternoon. He was very broad minded about it. He said, "Now, don't interfere with them. If they want to sit down and talk with you, OK, but don't force anything. And, if it bothers you too much, just take the afternoon off and go home." Well, I didn't want to do that. I was in hopes that I might be able to talk to these people. The pickets didn't show that afternoon. So I got interested, and I called the police and said, "What happened to the students that were going to picket engineering?" "Oh," he said, "on the way over to engineering we don't know what happened, but somebody apparently made a remark that engineering should be congratulated for what they're doing toward solving problems that are of an engineering nature. The people that are really not solving problems are sociologists, so they went over and picketed at sociology." Well, following that there was a sit in, a teach in, whatever you want to call it. And a couple of hundred students wanted to sit down and talk about these problems. They held this at the Shakespearean theater. They invited two from the sociology department, one economist and myself as an ag engineer to come to this meeting as resource people to answer questions. We were not going to be allowed to make any speeches. All we could do was answer questions. And so the four of us got together to decide how we were going to get into this thing. The decision was that we would show some film just to open up and get things going. They said, "You can have fifteen minutes to show film." They asked me what I wanted to show. (And, the

Bainer: students were agreeable.) I said, "I'd like to show fifteen minutes of the Council of California Growers film called Horizon," which was an excellent film. I don't know whether you've seen it or not, -- it's a tremendous film. I've seen it about a half a dozen times. And I said, "I'd just like to pick out some parts of that film to show some of the myths, you see, that are connected with this whole mechanization deal, and the importance of agriculture and all its ramifications to the total economy of California."

The other group, the sociologists,decided they'd like to show excerpts from the documentary film that was called the Harvest of Shame which showed migrant labor on the east coast moving between New Jersey and Florida. It was a horrible film. I don't know whether you saw it or not, but it was really horrible.

Well, I only had a certain amount of time available to me the following morning so I had to go over to Nearing's office and pick out the fifteen minutes I wanted to show. Then the sociologists came in after I was there and selected a section of the other film. Fifteen minutes of each film was shown to start this meeting. I felt bad because my part came first. I was hoping my part would come second, as a kind of rebuttal, but it worked out better to have my part first.

Well, there was one graduate student, a girl, that was really a leader around here, and she was really quite an influence. And when my part of the film started I noticed she walked out of the audience and went off and wouldn't even look at it. I tell you, this really upset me no end. And then came along the film from Harvest of Shame. I tell you, it really was a shameful situation. Highly exaggerated, but I'm sure there were instances where it was true. Well, the point was that I made use of this in answering questions. I said, "Do we want to perpetuate the situation we saw in Harvest of Shame? I mean, if you're going to perpetuate hand labor on the farm and all this migrant labor, you're going to perpetuate what you saw here."

Well anyway, the session went on for four hours and a lot of questions were answered. And every chance I had of course I got in my oar a little bit. Well, I'm just going to hit one or two of the highlights.

Everything was kind of moving along and I got to tell the tomato story. It was news to these kids, you see, they didn't realize that the Congress of the United States had stopped importation of foreign labor, and that we had been dependent upon foreign labor to pick our tomatoes. Just as a sample, eighty-five

Bainer: percent of them were picked by Mexican nationals. And when they couldn't come anymore, what are you going to do?

Well, you can try to use domestic labor which we did -- had educational programs to teach people how to pick tomatoes. We put the bee on labor unions. They were kind of getting active. We said, "Will you guarantee to have a crew out there at any price?" They couldn't recruit pickers. Of course the machine entered the picture. It was pointed out in this documentary, Horizon, that the jobs of many people in the State of California depend upon agriculture. Processing, transportation, steel, paper, banking, petroleum, etc. Finally one little girl got up and directed a question to me. She said, "Now I understand that you've developed a grape harvester so that the rich people can have grapes to eat while the poor people eat beans."

I said, "Let me tell you something. This is a wonderful question you've brought up here. Do you realize that if the beans that the poor people have to eat were produced entirely by hand, including soil preparation, planting, cultivation, harvesting and threshing and you insisted on paying a decent wage, they couldn't afford to buy beans. Those beans are completely mechanized that they're eating. It's poor people food, but they're completely mechanized and low in cost. I told my experience in Japan where it took 900 man hours (woman hours) to produce an acre of rice and we do it for seven and a half in California with machinery." I said, "If we had to put that many man hours into California rice, we couldn't afford the rice." I said, "What are you going to eat?"

There wasn't any comeback. I said, "One final remark," I said, "You people, all you students in here realize that if we reverted to hand-operated agriculture, and didn't have a single machine to do any of this work, that everybody in this room would be out on a hoe handle trying to eke out an existence, and it would be a pretty poor existence as far as food is concerned. You wouldn't have the time or money to attend the university, you would be out there on a hoe handle." So we finally got down to real cases. You see, they wanted to bring those people who were picking grapes into the university and give them an education. I said, "Listen, you've got to be practical about this thing. You've got to start at the grass roots level and start educating those youngsters in the local schools, and in the high schools where they have vo ag or vocational courses and continue in the junior colleges. Eventually some of them might be qualified to come to the university." I said, "But to think that this university can go out and teach them in their home area, it can't be done. You've got to come

Bainer: through an intermediate route."

Well, the session finally ended. The thing that made me most furious was this little gal that walked out on the film and wouldn't even look at it, came in with a resolution at the end of this meeting which was all typed out. Prepared before this meeting was ever thought of and tried to present this resolution which closed this University down for four days in sympathy with these people. Now, I felt we were trying to discuss what we were going to do and she had her mind made up before she came, and tried to force this resolution. It just fell flat, and that was the end of all that bickering about what are we going to do about these people. Well it was a long four hours. I haven't told all that happened, but I've told enough of the highlights, and when you had answers to these questions these students were sensible about it. The trouble with so many people in this critical period is that they just don't have a broad enough picture. They just don't have all the facts and don't know what's behind these developments.

Dickman: Continuing to look into your crystal ball, what else do you see for the future?

Bainer: Well, I don't see a whole lot more reduction of the number of people on farms, what I see is a continuation toward larger farms, but I don't think in terms of corporation farming as much as big family farms in which several members of the family are involved. I hope we stay in that direction. I'd hate to see this thing go in the direction where the corporations did all the farming. I don't think a corporation can weather the variations that agriculture has to contend with as well as a family. In other words, a family farm, if you can get right down to the problems of the farmer and his wife and the family can produce a considerable amount of the food that they need, and they can weather the adversity in lost crops or droughts, or what have you -- insect infestations, that wipe out a crop, and live through the next year -- they have to tighten their belts, but at least they'll live through. But we've seen, I mean just since I was in Davis -- I would say the number of farms that are in the United States are reduced to about one half what they were when I came here, and certainly in California the number of farms has been continually reduced -- there's been a continual reduction. We have less than eighty thousand farms in California, and less than four million farms in the United States. And so there is this trend toward large operations because the amount of power that a man has under his control in the farming operation has been increasing, and he can get more work done in a day is what it amounts to. I think we're beginning

Bainer: to reach a limit as to the maximum amount of power that we can use because of the traction involved. In other words you've got to be able to transmit this power to the ground in order to pull a load, and pretty soon there's a certain limit to how much you can transmit through rubber tires for example. It's been surprising to me how far we've moved towards larger pieces of equipment, tractors and machinery, and the amount of work that a person can do, and of course you can work twenty-four hours a day if you're really pressed, so I would say that we'll have a lower number of farmers operating larger farms. In other words, the farms are getting larger and the numbers are reduced.

Dickman: What about the source of power, will there be any changes?

Bainer: Well, I expect there will be. I've been very much interested in the reports of the Bureau of Mines in the March 1972 issue of Agricultural Engineering relative to some energy conversion work at their laboratory at Pittsburg, Pa. in which they are converting solid wastes into oil of low sulphur content. Whether or not this will ever be practical remains to be seen, but it's a high-temperature, high-pressure process that will convert cellulose material to oil, and this oil has a high quality. I suppose the problems that we've all been confronted with in the utilization of agricultural wastes is the dispersion of the wastes. To operate a plant such as this, there would have to be a concentration of raw material. For example, a feed lot with ten, twenty, or thirty thousand head of cattle would be a logical source of wastes. Likewise the conversion could utilize the waste from a city. Because of the pollution problem there is renewed interest in steam engines and turbines, gas turbines, wankel and diesel engines. Some of the diesel engines can meet the emission standards set up for 1975. The gasoline tractor engine will probably follow whatever happens to the automobile engine. The latter has been a great factor in the development of the tractor because of the reliability built into automobiles. The materials that are used are now available for the manufacture of tractors. The tractor industry was depended upon the automobile industry to lead the way, and I think they will continue to do so.

I think that the tomato deal is a beautiful example of this, and I think it's going to happen to other crops. One of the things that we're going to see more and more of, I'm sure, is air transportation of perishables, which means that we can keep the crop on the vines or on the trees a little longer to improve the quality and then move it very rapidly without auxiliary refrigeration in the air. The planes operate up there where you've got refrigeration available in any quantity that you want. We're shipping flowers and strawberries by air. I don't have recent

Bainer: figures, but when I was on the study of the Institute of Transportation, I was amazed at the thousands of tons of strawberries that was shipped by air. In the early season -- like this year we had an extremely early season on asparagus. Even in our own market early asparagus brought fifty to sixty cents a pound. It was a luxury item. This early asparagus can be shipped by air to eastern markets and I'll tell you, when they get their very first green vegetables direct, people will pay quite a bit. There's a class of people that will pay exorbitant amounts for this vegetable. So, as I say, we'll use more and more air transportation.

I don't know what's going to happen to yields, they're going up all the time, and that again is going to be a factor in overall agriculture. Certainly it's going to be a factor in developing countries. I've been talking to the people from Thailand -- they were here three or four weeks ago -- relative to what they're going to do at Kasetsart University. We were told by them that they were using the new variety of rice that came from IRRI in the Philippines. This would be IR 5 and IR 8. They told me that it was the basis for their production. That this rice that came from the Philippines wasn't as acceptable taste wise as their own. Also it wasn't as disease resistant under their conditions which meant that they used this new rice as a basis to cross with their own varieties and still keep the yield up to meet their own requirements. And so you're going to have increased yields, and this is going to go a long way toward feeding the world.

OBSERVATIONS ON THE SELECTION OF RESEARCH PROJECTS AND THEIR USE IN THE LAB AND CLASSROOM

Dickman: Who keeps track of all of the research in the department to be able to relate the research one team is doing to something another team may want to do?

Bainer: I suppose the first answer to that is to be around for a long period of time. After all, I was at Davis for some 40 years and a considerable amount was accomplished over this period, and if you have a fairly good memory you can keep track and refer back. One of the things that I learned from Professor Walker was the art of making a concise monthly activity report. Each man made a report every month of how he used his time -- teaching, extension, research, what was accomplished in a nutshell on his project, who his visitors were, what his trips were and what was accomplished on his trips.

One copy of the activity reports was kept in his desk, and he never put them in his desk until he'd read them. And so that's one thing that I inherited from Professor Walker. We maintained this idea of activity reports. The second thing is that we insisted on regular reporting of projects, and these were filed in the main office under the project file number. And again, Professor Walker, and I followed up, would never let the secretary file these project reports until they'd been read. And so if you read everything that the men do every month and keep abreast of his project accomplishments before they're filed away you begin to build up a store of knowledge. The third thing which was very effective and I'm sorry isn't carried out at the present time was a brown bag noon luncheon in which a staff member had thirty minutes to tell about his accomplishments. He had a chance to tell the rest of the staff what he was working on and what he was finding out. Sometimes it had to be continued over more than one luncheon period in order to cover a particular subject.

And then, of course, we had on top of this regular seminars with graduate students, and the staff would get a chance to relate. And then, we had staff meetings at least once a month. These staff meetings would run for two or three hours sometimes. I just went right around the room and put my finger on every researcher to find out anything exciting that's happened, any

Bainer: problems that he had, and what he needed, etc. We were a close-knit group, and when you're close-knit, lots rubs off of one onto another.

There was a chief engineer of the John Bean Division of FMC by the name of Roy Magnuson. Roy and I became acquainted many years ago. We had a standing invitation between us that he would come up and visit here for a day and I'd go down to Food Machinery and visit for a day. One time Roy came up here and I had a class -- the first hour or the second hour in the morning -- so I said, "Roy, just go down in the research shop and make yourself at home and I'll be down in an hour. Or, you can come to class, I don't care which." He said, "Well, I'll go down and browse around." He told me afterwards, "If I could have the same cooperative attitude, the same helpfulness that I saw displayed in your shop down there, I could whip the world." He said, "It just seemed like (there was half a dozen projects being worked on down there by that many people) there was an exchange of ideas. A man was having a little grief with something and he'd call somebody else and he'd come over there and they'd talk about it and this fellow didn't hold back. In my place of business, the guy with an idea would hold it back until he could try it out himself, and he wasn't going to give it to somebody to try in another way." So I often remembered the real compliment that he gave to our staff here in being able to cooperate and work together and exchange ideas.

Dickman: Could you use any of these get togethers for recruiting? Did you ever have a prospective staff member come to those sessions? I think you told me that you met after your faculty had met one of these prospectives and you decided that you wanted --

Bainer: Well, I don't think we ever did have a prospective member at one of these meetings. One student-activated course that we offered here, I think was one of the most worthwhile things we ever did in our relationship with students. Our seniors came in one year and wanted to develop a course in which the researchers would come in and tell them what went through their mind as they developed a problem. They didn't want particularly the answer, but they wanted to know -- when you were given a problem how did you approach it? What were your thoughts and how did you develop it? To me this was a real challenge to our staff, so we worked up a whole semester program and we gave it as AE 198, we had flexibility, and could give this and give students credit for it. I could see the usefulness beyond the students. I could see some of the old timers coming in and telling their experiences that some of our younger staff members had never heard. So, it was not only students who took this course. I insisted that

Bainer: every young staff member come in and audit it. And it was a great course! I wish that I'd taped that thing from beginning to end. It was absolutely fantastic, and it made people think back, and give their experiences. And as I say these students didn't want to hear anything about the final answer. They said, "We can read that in the project reports and in the journals. We know what that was, but what went through your mind?"

Dickman: Were you trying to get at the heart of creativity?

Bainer: That's right. We were trying to get at the heart of creativity.

I gave a rather popular, I think, set of demonstrations here for visiting future students like the 4-Hers and the Future Farmers, and the science clubs for northern California. The title of my demonstration was the "Birth of an Idea." And I did this very same thing on a half a dozen ideas that had been developed in ag engineering, and accompanied them with demonstrations. It always started out with the walnut cracker. Ernie Head would help me on the stage. I've done this in Freeborn Hall with an audience of 2,000 kids. I've always regretted that I didn't have a sound camera to get the response of that group when that walnut exploded. Because no matter what you had told them -- the noise of the explosion was a great shock. We went through the act of sawing the hole through the shell, filling it with gas, and exploding it. And when that thing went off it sounded like a shotgun. And the kids, of course, were wide awake from that time on.

Dickman: Was this for new freshmen?

Bainer: Well, no. These are all high school kids. 4-H and Future Farmers and the -- And then we had here for several years science students from high schools from a radius of a hundred miles. There were 1500 - 2,000 kids that came in here for four hours on Saturday mornings for a month or so. Somebody on the faculty would put on some kind of a program for them. As I say, I was called back for repeat performances. I gave this demonstration so many times that I felt actually embarrassed. But, it was a different bunch of kids each time.

Dickman: We've been talking about research. What is the value of research to a teacher? Can you be a good teacher if you haven't done research?

Bainer: Well, to answer your last question, I have had in my college career a few really outstanding teachers that were not researchers,

Bainer: but I would say they are the exception. Our setup, for instance, in ag engineering probably was more favorable to the researcher than many of the other departments certainly in engineering. My teaching load, for example, was about twenty percent and maybe five to ten percent in extension. That left me seventy percent of my time for research. My feelings are that a man doing research keeps abreast of what's going on in the field, because he reads the literature, he has personal experiences, which fortifies teaching. It keeps his teaching alert. It keeps it up-to-date. I taught a course to senior students for almost 25 years in which we had no textbook. We taught it through the literature, and the student actually read the literature and reported to the class. They got not only experience in searching out the literature, but the experience in reproducing it for the class.

So, that course was never taught the same in two successive years, never once. It was alive all the time -- there was change. I gave another course which was a lecture course for beginning students, in which I never taught it the same any two successive years. I couldn't. I mean there was so much going on in my own experience as well as the experience of others that was injected into that course. So, I think the real fine combination is a man that does good research, and at the same time is able to interpret the results to his class and give them the benefit of it. You know, many of our textbooks are almost obsolete by the time they're printed. From the time you start working on a textbook it takes a year or more to prepare the manuscript and another year to get it out, and so two or three years have gone by, and so much is happening in that period that some of the things in the textbook are obsolete. So, I don't say that you can't be a good teacher and not do research, but I think it would improve anybody's teaching if he did have research experience.

THE HIGGINS COLLECTION

Dickman: The Hal Higgins collection is a great asset to the University Library. Please explain what it is and how the Library came to acquire it.

Bainer: One of the first men that I met when I came to California in 1929 was Hal Higgins. At that time he was employed by the Caterpillar Tractor Company in their public relations department. One of his responsibilities was to take photographs of Caterpillar Tractor equipment in operation, and he was a very good photographer. The result was, in those early days, Caterpillar released many, many excellent pictures of tractors in operation. I met him at a tractor driver's contest at Brentwood in the fall of 1929.

Dickman: Were you in the contest?

Bainer: No, I was one of the judges. Professor Walker was asked to send a couple of people down to judge this contest. They called it a cat skinners contest, and Stan Winters, who was then in the Department of Ag Engineering, and I were delegated to go down to judge the handling of these tractors and it was quite a revelation to me. I'd never been around crawler tractors before because in Kansas they just didn't have them on the farms. One of the men taking pictures was Hal Higgins. He was introduced to me. The first thing he asked me if I was any relation to H. M. Bainer, who was on the staff at Iowa State College when Higgins was a student, and Higgins had taken a class from him. Well, of course, that was my father. And this started a long relationship. I soon found out that Higgins was a collector, and I mean a real collector -- you might almost define him as a pack rat. He was assembling historical materials on agricultural equipment and technology. By that time he had quite a library. Everytime he came to my office in Davis, which he did frequently, especially during the sugar beet mechanization days, he was always wondering if I had something to donate to this library of his. And I really didn't get the significance of it for a while. I soon found that he'd take anything, and when I had boxed up a lot of old catalogs for example, that we had no room for and was about ready to throw out, he said, "Don't you throw out anything," and some of this stuff dated back to when I was a kid on the farm, back in 1918 when I was interested in tractors. We farmed entirely with tractors. I never owned a horse, it was always tractors from the very beginning. I used to get the <u>Tractor Redbook</u> which was put out by one of the publishing houses. It described every tractor that was on the market

Bainer: and all their specifications. I could tell you about most of these tractors even though I only owned a couple of tractors in my operation. But, being a country boy I felt that one of the things I should be up on was tractors that were available and their specifications. And so some of the stuff that I had dated clear back to then. I just boxed it up and gave it to Higgins and I suppose it's someplace in the library.

Soon after I came to California, Caterpillar moved their headquarters from San Leandro and Stockton to Peoria, Illinois. Higgins left the company at that time and became a free-lance writer and wrote for several magazines and trade journals. Of course, he was always desperate for material and was always hanging around for any tidbits that anybody could give him. He lived in Oakland for a time. Finally he lost his wife. Well then he didn't want to move in with his son and his family so he made an arrangement with them to build a home in Walnut Creek. This home was built on a side-hill at the edge of town. He used the lower floor for an apartment. And it had room for his library. The son and his family lived on the street level up above. Well, he soon realized his son had no interest in this library. I think he got scared one day as a result of a fire that swept across the hills. The question was whether or not it would be extinguished before it reached his home (which fortunately it was). It indicated to him that he was in danger with this library. I suppose he had some sort of insurance on it but much of the material could not be replaced.

Furthermore, Higgins was getting along in years. One of the things that happened soon after he moved into this house was that the Caterpillar Tractor Company, which had been in existence for fifty years, decided to put out a book, "Fifty Years on Tracks." When they started to assemble this book there was a lot of missing links. They knew that Higgins had been a collector -- and Higgins never threw anything away I can tell you [laughter] -- and he had beautiful photographs and newspaper items and magazine items, old books and the like. So, Caterpillar made a deal with Higgins to come out and use his library to prepare the manuscript for "Fifty Years on Tracks." I understand that they sent a couple of girls out from Peoria to catalog the material pertaining to Caterpillar Tractors. And he kept this stuff pretty well segregated so that you could pick it out. I began to realize the importance of this library when a company like Caterpillar, who you'd expect would have the complete story from beginning to end, didn't have all the facts they needed. They used the library and paid him a couple of thousand dollars.

Bainer: One day he mentioned that he'd like to dispose of the library. He had indicated that when the library was up for sale another institution, Michigan State University, became interested right away. Well, Hal hated to see this library moved out of California, he'd been here for so many, many years. He said to me, "Do you suppose that the University of California would be interested in purchasing this library?" I said, "Well, I don't know, but I would assume that they would be but it's a matter of dollars. How much do you want for it?" And he told me fifty thousand dollars. I didn't know where we might find fifty thousand dollars around here, but before we began to look into this thing seriously I called Dick Blanchard, our Librarian, and asked him if he'd like to go down and take a look at the Higgins Library. He said, "Sure, I'd like to go." So I made arrangements and we went down. And of course, it wasn't too well organized, I mean he had file after file of cataloged material pretty well segregated by company and crops and so forth. But it wasn't something that you could just walk in and find everything you wanted right off the bat. I was a little disappointed because Dick didn't warm up to this purchase -- especially at fifty thousand dollars. I suppose he was wondering where he'd get fifty thousand dollars, and said, "I'm just not interested in trying to get this kind of money together to buy that library." So I brought him home, and as I say, I was a little disappointed, I thought here was something that could put Davis on the map as far as certain historical material was concerned. I knew there wasn't anything else like it in the world. The agricultural library of the USDA had quite a bit of stuff but nothing like this. I didn't know what my next move was going to be. One day I saw Jim Shideler of the history department who had set up an Institute of Agricultural History. I said to Jim, "You know, I took Blanchard down to take a look at the Higgin's collection and if you'd like to go down I'd like to take you." "Oh," he said, "I'd like to go!" So we made a date to go down there, and I thought in all fairness to Dick we should tell him what we were doing and invite him to go. So Dick said, "I'll go down with you." So Dick went down with Jim and I, and boy, I'll tell you, when Jim took a look at this material -- you see, he looked at it in a different light entirely than Dick was looking at it. He was looking at it as source material for graduate students in agricultural history, and here was just volumes of material that could be worked over and result in theses for graduate students. We had a problem getting him away from that library. We stayed there three or four hours, and on the way back Jim expressed himself as being very much interested in the library.

Bainer: The next move apparently was that Dick Blanchard thought, "Well, maybe I'd better talk to the Bancroft people at Berkeley about this thing." So he went down and talked to them and described what Higgins had collected over a period of forty or fifty years. And the Bancroft people said, "You buy that library. It's even cheap at fifty thousand dollars. It'll give Davis something unique in the library to have this material. We know there isn't any other collection like this in the wide, wide world. Just don't waste any time in getting it." This kind of fired Dick up a little, and of course with the Bancroft people telling him to buy this library, and Shideler telling him he'd like to have this library, then what's the next move? I was on the patent board at the time, and Vice President Robert Underhill was chairman of the board and secretary and treasurer of the regents. I had an in with him. I mean I was very well acquainted with him. I didn't hesitate to tell him what my problem was, and I thought this is at least one lead as to whether or not funds might be made available. Where else could we expect to get them, you see. Well, Bob Underhill warmed up to the project right away. And he said, "I think we could get the regents to loan you the money to buy that library"-- loan it to me, personally. "At the same time, the regents should authorize you to solicit money from the big implement companies to reimburse them for the library." He said, "Of course, I'm a very shrewd dealer on things like this, and suppose we just ask the regents for twenty-five thousand and you go down and see if you can buy it for twenty-five thousand dollars." I said, "I don't think there's a prayer of getting that library for twenty-five thousand dollars. In fact, I'm embarrassed to go down and only offer the man twenty-five thousand."

Well, you know Bob Underhill. If you knew Bob Underhill you'd know that he drove a hard bargain. The next thing I knew, they set up an account here at Davis in my name to buy the Higgins library for twenty-five thousand dollars. So, I told Blanchard of the action. I went down as an individual. As I say I was embarrassed. I talked to Higgins for a long, long time. I told Higgins just exactly what had happened, that the regents had loaned me personally twenty-five thousand dollars for which I was responsible to reimburse them for. Actually what the regents did was to authorize me to raise seventy-five thousand dollars so we'd have money to catalog and operate on after we paid back the original purchase price. I told Higgins that Blanchard was offering him an office when they moved the library to Davis. He would be the curator -- at no salary -- and that it would be known as the Higgins Collection. Well, this appealed to him. He wanted

Bainer: to get that library out of the house before it burned down, you know, and so about two o'clock in the afternoon he said, "If twenty-five thousand is all you've got, I guess you've bought a library." And so, I came back. He said, "Now, I don't want the twenty-five thousand dollars in one lump, I want five thousand dollars a year for five years." So that kind of spread it out. And so we bought a library, and they didn't waste anytime moving it to Davis. It was in two or three temporary locations before the last addition to the library. Now it's on the fourth floor of the library in the Special Collections Section. Some progress is being made to catalog it.

Then my next move was to find twenty-five thousand dollars to pay the Regents. So I thought, well the place to start was where I was better acquainted. That was with International Harvester Company Foundation. I wrote to McCaffrey who was the president and told him what I wanted to do, and that I wanted to stop by and see him. I was making a trip back east and I thought, "Well, I'll hit two or three of these companies while I'm back there." And so I figured the best chance to get money was from International Harvester Foundation. And so I went to Chicago and McCaffrey had a luncheon for me at the Chicago Club and had the people from the Foundation. Of course, he helped me sell this idea and they all fell for it. My idea was that there were at least five companies that I should be able to get fifteen thousand from each. That would give me seventy-five thousand. And so, I should have asked for more, I guess, but I asked for fifteen thousand dollars over a period of three years -- that would be five thousand a year. Much to my surprise I got the money. Well, this gave me a leverage, you see, after all I'd gotten money from the IHC Foundation. My next move was to John Deere, and of course I knew Bill Hewitt, the president of John Deere, personally because he used to be in the branch in San Francisco. He married into the family that was in control of John Deere. I didn't get fifteen but I got ten from them. And then, of course, I had poorer luck. Some people turned me down flat, and then came through in later years with money. I don't know how much total was raised.

Dickman: You got three thousand from Allis-Chalmers.

Bainer: Yes, and we got some money from Food Machinery, but that's about all. Caterpillar who had used this library just turned me down cold, and this was the thing that kind of amazed me because Underhill gave me a list of companies that the University had loaned money to or owned stock in. The endowments

Bainer: of the University of California were very significant. I guess they are second to Harvard and this money is invested all over the country. Bob Underhill dragged out a list of stock that the regents owned. The holding in Caterpillar was one of the biggest. Well the point was, I never could see the proper people at Caterpillar. I was there a couple of times, and everytime I went the man I thought I was going to see was away and I was turned over to somebody else down in the organization. I never got to first base.

The money didn't all come the first year. After about two years the business office started calling up and dunning me for the money that I still owed the regents. I began to think, toward the end, that I was going to have to kick in personally, after all, to keep in good graces with the regents. It just amazed me that I got dunned every year for the balance, and I'd have to write a letter. Well by now I have cleared up that account.

I then went after a second batch of money to help with the maintenance and the cataloging of the library. We got another ten thousand from the International Harvester Foundation. I think they just finished the last payment this last year. It was an interesting experience. Of course I didn't work too hard raising the money but I did go to the top of these companys. I could have gotten money from the Ferguson Foundation, but they were non-existent by then. They'd given away all their money. I went to the Massey-Ferguson Co. in Toronto, and I got some promises of some help but they preferred to do it in another way, to -- help maintain the textbooks which I didn't quarrel with. In fact when we revised the textbook on machinery they gave us another five thousand dollars to cover the expenses. And they did the same for other revisions.

Well, I thought another place I'd get some money was at Ford. They were in the tractor and machinery business. I knew the vice president of Ford very well because he'd been here in Oakland before he moved up the ladder at Ford. He promised me that they'd do something but it was only a matter of a couple of months before he left Ford and became president of the Case Company, and that was the end of that relationship. We also tried to work on other individuals, but it's hard to get money for this sort of thing. We, at least, got the library. Now it's being used I think very effectively, and will be more and more as the days go on.

Dickman: I think that it's remarkable that you went on the hook personally in order to buy this library.

Bainer: Well of course, I felt that this was a very worthwhile project. I had no qualms or fears about raising the money. In other words, when Underhill said "We'll have to loan this to you personally, and the regents will authorize you to go out and raise the money to reimburse them." I had no fear, I was sure this could be done.

Dickman: You could be made an honorary librarian.

Bainer: [Laughter]

SECURING RESEARCH GRANTS

Dickman: How were some of the other projects financed?

Bainer: We already had a history at Davis of getting outside grants in ag engineering. Many were volunteered. We had grants from tomato growers, raisin growers, prune growers, CREA, etc. You know it was just amazing. At one time we had a problem come up at Bakersfield in potato handling. The Bakersfield farmers were semi-mechanized in growing potatoes.

Dickman: These are Irish potatoes, not sweet?

Bainer: These are Irish potatoes. Well anyway, they had some problem with disease. Jim Kendrick went up and took a look at this problem and he said, "Well, no use of me working on it. The problem is that you're putting these potatoes in the sack wet. All you need is a potato drier. You get those guys at Davis to work on this thing." He recognized the problem right off hand. (James Kendrick is a Davis boy. His father was chairman of plant pathology here, and his two sons followed in his footsteps. Jim, Jr. was at Riverside in plant pathology, and now he's vice president for agriculture in the university.) Following his recommendation, the potato growers gave us a grant to work on this problem. Jim Tavernetti went down and built them a simple drier and that was the end of it. And, you see, the money often came with the problem. Nothing breeds success like success, you know. So -- we have been very fortunate in financing projects around here.

Well, when we were talking about financing, there was one afternoon well spent that I should relate. I mentioned way back that through regent action the Davis College of Engineering was extended to include Livermore. We put up some temporary buildings down there for classrooms, offices, and a small library, and the program in applied science went over very, very well. We'd never been able to get Vice President Wellman down there to see this operation. So one day he called and said he was available and we made a date to go to Livermore. I called Chancellor Mrak and he could go that day and I asked Dean Garland to go with us.

We were to meet at Livermore at a certain specific time. The day before we were to leave I received another telephone call from Wellman and he said, "Why don't you fellows come to Berkeley and pick me up and we'll all go down together." Just off hand it sounded rather ridiculous because Berkeley is as far from Livermore as Davis. But after all if the vice

Bainer: president of the university says "come down and pick me up," what do you do? So, we went down and picked him up. It was 1966 and we were just about ready to move into our new building. On the way down Dr. Wellman said, "When are you going to get into your new building?" And I said, "It looks like we're going to get in early. The contractors are ahead of schedule so we were striving to get in during the Christmas vacation" -- which we did.

Well anyway, Wellman said, "Do you have enough money for equipment?" Actually the appropriations for buildings carry equipment money -- about 20 percent of the building appropriation is for equipment which meant we had a million dollars for equipment. When he asked the question -- I should preface this by saying we had been working through the chancellor's office here to try to get this allotment increased by about one million dollars because one million dollars worth of equipment was way below our needs. We'd already picked up three quarters of a million dollars when we were in Walker Hall, but even at that it wasn't near enough. We had made a survey of the staff and had everyone get their items in which totaled to a million, nine hundred thousand dollars. So when Wellman asked me whether or not we had enough money for equipment I said, "No, we do not have." He said, "How much do you have?" I said, "About a million dollars." He said, "How much do you need?" I said, "Well, close to two million." He said, "Why don't you get your request in?" This was before the governor found the twenty million dollars in the regents sock. The regents had been hanging onto money resulting from overhead on federal contracts and had accumulated quite a sizeable sum of money. The governor finally found this and made them use it a few years later.

Well anyway, Garland and I came home. We went right to work making up a new equipment list, and it came to something over two million dollars, and we submitted it through channels, to Wellman, and received better than a million dollars additional money. I tell you, that was the most profitable afternoon I ever spent in the university.

DEVELOPMENT OF THE COLLEGE OF ENGINEERING

Dickman: How did the College of Engineering develop?

Bainer: The college developed in a rather shoestring manner, you might say. When the College of Letters and Science was started at Davis, professional courses in mathematics, physics, and chemistry became available.

Dickman: What year was that?

Bainer: That was 1952. So, when these basic courses became available we could give the first two years of ag engineering at Davis. As was mentioned before, we had an arrangement with the College of Engineering at Berkeley to take our students for the first three years and we had them as seniors. It wasn't long afterwards that we instituted the freshman and sophomore years in agricultural engineering. We had volunteers from the staff to teach surveying, descriptive geometry, statistics, and dynamics.

This situation put us almost in the category with a junior college. Any engineering student could come to Davis for a couple of years and transfer and go to other fields of engineering. While we were trying to drum up a little more enrollment in agricultural engineering we were actually servicing students in other branches of engineering.

Along about 1959 President Kerr set up a state-wide committee to look into the future of engineering education in the university. I was the Davis representative, and there were representatives for all other campuses there. Dr. Pitzer who was then dean of chemistry and headed up chemical engineering at Berkeley was the chairman of the committee. Dr. Brode was the liaison between the committee and the president's office. We started holding meetings at Berkeley in a regular manner, and one day out of a clear sky Dean Pitzer said "It seems to me that the logical place to start a new college is at Davis because of your long relationship with engineering at Berkeley, and you have quite a few engineers at Davis. Suppose that the next time we have a meeting that you come in with a program that you can implement at Davis immediately." Well, I came home and got the staff together. We set up subcommittees: one in electrical engineering chairmanned by John Powers, one in mechanical engineering chairmanned by Allan McKillop, one in civil engineering chairmanned by Vern Scott of the department of irrigation, one in ag engineering headed by C. F. Kelly and one in chemical engineering

Bainer: headed by Dr. Joe Smith, who at the time was in food technology. We had several meetings of the chairmen of the committees, and decided on certain policies. First we would start as a single department of engineering. We would have a common core program for all engineers, for practically three years. This meant that a student did not have to declare a major until he had been here for two or three years. To give flexibility, the upper division program was high elective. Then these subcommittees went to work and developed programs in the five areas. We did not want to prescribe every single course that a student took. We had a list of what we called approved electives in all of the areas, and the student was at liberty to make up his own program using selections from this list of electives. Well, I went in with this program, and I thought maybe I might get into trouble by the fact that we had a program in chemical engineering in the College of Engineering at Davis which is a normal place for chemical engineering. But, if you went back in the history, you found that chemical engineering at Berkeley was at one time in the College of Engineering, and it was apparently unsatisfactory to the College of Chemistry as to how it was handled. The first thing they knew, the College of Chemistry developed a program of chemical engineering. And, of course, Pitzer was the chairman of this program. I thought when I went in I'd have my head chopped off because I put chemical engineering in engineering. Well, I presented this program and much to my surprise it was adopted by the committee and submitted to the president. And, nothing was said about chemical engineering by the chairman of the committee.

At the end of the meeting I had to go up to the College of Engineering, and I knew Pitzer had to go up to chemistry, so I said, "Do you want to ride over to the campus?" I had a car parked in the University garage right across from the administration building where we were holding forth. He said, "Yes, I will." I said, "I was a little surprised I didn't get any kickback from having chemical engineering in engineering." He said, "If you want to know my opinion, that's where it belongs." And Pitzer personally came to Davis and talked to the people in chemistry and told them that "this program is going to be in the College of Engineering and just let it alone and see how it gets along."

I came home and everybody was all excited. So we put the new program together and presented it to the faculty here at Davis. They really didn't have to give approval, but we wanted to keep them informed of what we were doing. Well, there were two or three people on the Davis faculty that got up at this

Bainer: meeting and expressed themselves that the program was just too tough for a four year program. They really felt that it either ought to be extended or watered down, one or the other. Well, it kind of provoked me a little bit. After all, we were just telling them what we were going to do because we had the authority to go ahead.

Well anyway, the next move was how are you going to implement it and get it started without delay. So I checked with Vice President Underhill and Freeborn who was the Chancellor, and I checked with Berkeley and we decided that the quickest way that we could possibly get this college into operation was to get the Regents to extend the College of Engineering at Berkeley to include Davis, and that we would operate as a department in the College of Engineering at Berkeley.

Well, no one knew how to present this to the Regents. I remember Howard Shontz was the registrar and had a book with all the standing orders of the Regents. I borrowed it. After I mulled the standing orders I wrote an amendment to expand engineering at Berkeley to include Davis. I remember taking it over to Freeborn's home on Sunday afternoon because the Regents were going to meet the next week and I had to have this at Berkeley -- I think Tuesday was the deadline if you wanted to get on the docket for their Friday meeting. Freeborn looked it over and said, "I don't see anything wrong with it." The Regents authorized the amendment and we had a department at Davis.

Dickman: What year was that?

Bainer: This was '61, it was in the spring of '61. We had, of course, a lot of help from Berkeley. John Whinnery, Herbert Scott and Associate Dean Garland came up and spent some time with us. Whinnery was appointed Dean of Engineering at Berkeley the following fall. I remember Powers asking Whinnery whether or not our program in electrical engineering was adequate for a college program. He said, "It's minimum, but adequate."

I remember going to Berkeley with Dr. Smith and having meetings with the people in chemistry and chemical engineering. They felt that what Smith had put together in chemical engineering was certainly adequate. The only question I asked them was if a student went through this program at Davis and graduated, would you accept him as a graduate student if he was qualified otherwise? They said, "Sure." That's all I wanted to know. Well, Dr. Smith was no novice in chemical engineering because before he came to Davis he was chairman of Chemical Engineering at Northwestern University. So, he knew his way around.

Bainer: He'd been at Purdue also.

Well, several things happened following this. Smith never felt at home in food technology. He had always been in chemical engineering, and he had to explain what he was doing, you see. There was plenty of chemical engineering in food technology, but he never felt really at home. And one day we got wind that Santa Barbara was going to start a chemical engineering program, and they had offered the chairmanship of the Department of Chemical Engineering to Dr. Smith. Well I went to George Stewart and told him, "Boy, you're going to lose this man to Santa Barbara." We'd already given him a title in engineering even though his salary was over in food technology, and that was all right with George. He said, "What do you suggest?" I said, "Well, we're going to need somebody at Davis to head up Chemical Engineering eventually, and he's the logical man for this." And George didn't want to see Smith leave the campus. He's a brilliant man and he thought having him here, he'd still get some help out of him. So, here was a full professorship in food technology, and all I had available was an assistant professorship at about half the salary, and I told George, "All I've got to trade for this man (and you had to trade positions) was an assistant professorship," and George said "I'll trade you a professorship for an assistant professorship just to keep this man on the campus." So, that's how we got Smith.

Well, one of the things that amazed me was that when Garland came up during the formation period he would say as he left "You're saving a place at Davis for me, aren't you?" And I thought he was kidding and was just trying to make me feel good and that things were going pretty good. After all, Garland had been at Berkeley since 1930 and I'd been here since '29, so we'd known each other all these years.

A funny thing came up when Coby Lorenzen took a sabbatical leave. He had been serving as a member of the undergraduate study committee at Berkeley, and Garland was chairman of it. So, I asked Charlie Beadle if he would like to go down and fill in for Coby on this committee. And he said, "I'd be obliged to just to see how things are done." He was a young staff member. So I called Garland and he said, "That'll be fine. Send him down." Well, about the second or third trip he came back and he came in to see me and said, "You know, I think Dean Garland wants to come to Davis." I said, "Well, I sure have been a dumbbell. You know, he intimated this way back when we were first developing this program, and I didn't think he was serious." Charlie said, "I'm sure he's serious." So I tell you, I went down to see Garland the next Monday. I caught him just as he was going into faculty meeting. I said, "Clyne, I'm just sick. I have been completely asleep

Bainer at the switch. I thought you were just trying to make us feel good." He said, "I didn't think you were taking me serious. I really meant it." And so, he came to Davis. We had him transferred up here in a hurry. And he came up because he wanted to get out of administration in Berkeley and get back to teaching and research. And we certainly needed a man in mechanical engineering that had his qualifications and could teach vibration theory.

Well, he came in here and I guess he taught for a year before I began to get loaded up as I was the only one in the dean's office. So I got him to come in part time to help me, and pretty soon it was full time.

And then we got into another more or less crucial period. Let me say first that we operated as a single department of engineering through '63. In '62 the regents authorized a College of Engineering separate from Berkeley and appointed me dean. During the fall of '62 President Kerr got a commitment from the regents to extend the college at Davis to include the Lawrence Radiation Laboratory at Livermore. In '63 a Department of Applied Science (Livermore-Davis) was organized.

Well, the first thing I knew, in 1964 the chemical engineering boys came in and wanted to have a separate Department of Chemical Engineering. They felt we were now big enough that we could kind of spread out. And they put it before the faculty and the faculty voted for it. That was, of course, the straw that broke the camel's back, because every other group, mechanical, civil, electrical and ag engineering all wanted to come in as separate departments. So we departmentalized at that time and it was good thing as far as I was concerned. We were getting too big, and boy, I'll tell you. The work in the dean's office was terrific when you consider everything funneled through there. I'll never get over how easy things suddenly became when we had everything funneling out through departments, and I was just in there kind of keeping things together, and it certainly took the load off the dean's office.

Well, about that time we didn't have a single full professor in the Department of Mechanical Engineering except Garland when we decided we'd departmentalize. The chancellor said, "You're not going to put anyone in as chairman of the department that is not a full professor." I said, "We only have one man in mechanical engineering and that's Garland and he's

Bainer: occupied in the dean's office right now and I just don't see how I can let him go." He said, "Well, you'll have to. He'll just have to be the chairman of the department of mechanical engineering." Well, we had another windfall. You know these things all just sound like accidents but they're very important in the early history of this college: Dr. Warren Giedt, who had been in mechanical engineering at Berkeley for many years talked to Garland one day and said, "Do you suppose you people could make a place for me at Davis?" He said, "I'm all fed up with Berkeley and I'm going to get out." That's when they started having campus trouble. So Garland came around to me, and here was this crackerjack, you see. And so I called Giedt up and he said he'd like to come up and talk to me.

He came up Monday afternoon and we talked for five or six hours. Oh, I was thrilled. After all this guy was the author of text books, and he had a big consulting practice and was a real terrific teacher. He soon received some awards on this campus for his teaching. Well, a transfer from one campus to another involves the exchange of positions. And here again was a man with a full professorship and all I had was an assistant professorship. A transfer from one campus to another in the University is made at the chancellor level. The all university conference was in session at Riverside. Garland was an official delegate from this campus to the conference, and of course the chancellors were there from all campuses. So after I finished with Giedt at six o'clock that night and found out that he was really serious, he wanted to come, I called Garland and I said, "Well, Giedt is ready to come and I think we ought to go all out for him. I would suggest since the chancellors are there that you get ahold of Mrak and give him the low down." I also said, "He'll be chairman of mechanical if we get him." Myerson was acting chancellor at Berkeley. And so Garland, Myerson and Mrak had a meeting and it was agreed at the top level that the transfer would be made.

Well I called Giedt the next day and I said, "You'd better get in a chair because what I'm going to tell you might surprise you a little bit, but I've been in contact with Garland and Garland's been in contact with two chancellors, and the transfer has been made." This was done in less than 24 hours. "Oh," he said, "I can't believe it. What'll I tell George Maslach?" Well, Maslach was the dean at Berkeley and he didn't know a thing about it, you see. I said, "I don't think you ought to tell him a thing. I'll call him." So I called George. And, of course, he was furious that the chancellor would transfer a man out of his staff without even consulting him, but he

Bainer: said "I can't blame you because you did it according to Hoyle." [Laughter] I said, "I didn't do anything that was illegal. I simply had the chancellors get together and they decided Giedt could come to Davis. And unfortunately all I can give you for his position is an assistant professorship." He took it in a good-natured way and it never destroyed our fine relationship or anything like that, but I was so glad that I called him up and broke the news so that Giedt didn't have to do it. Giedt didn't want anybody to know that he wanted to get away from Berkeley. If any underhanded thing was done I wanted to be blamed for it. So this shows how some of these things were done.

Well, we had another windfall and that was Dr. Don Brush. Don Brush was one of the top engineers at Lockheed down on the peninsula. And Don had been in an extra-curricular activity in Lockheed and was handling a combination graduate program between some of the young engineers at Lockheed and Stanford University. You know there were many Lockheed employees who were given time to go to Stanford and complete their work. These boys were getting pretty good salaries while they were going to college. They were getting twelve thousand dollars from Lockheed and a Ph.D. from Stanford.

Well, here was another man (something like John D. Kemper in that he'd been in industry ever since he graduated from Illinois) and he began to think he'd like to try the academic world. And so we got interested in him and hired him, and he was instrumental in bringing us to two other Lockheed engineers, James Cheney and James Hutchinson who had just finished their Ph.D.s, so we brought three in from Lockheed. And so Don came in, and when we departmentalized he took over the chairmanship of civil engineering, so we had a real top man there.

Harry Brandt was still another you might say was a windfall. Harry Brandt was a student of Garland at Berkeley and got his Ph.D. down there. When he finished he went with Standard Oil Research in mechanical engineering. Apparently Harry was in the same frame of mind as Kemper and Don Brush. So he talked to Garland. See, this was wonderful because Garland knew a lot of these people and they would talk to Garland as an intermediary because they knew him.

Well, we looked into Brandt's background and boy we needed him, we really needed him. So, we went after him, and there wasn't any problem getting him appointed. We brought him in as an associate professor. Anyway, Standard Oil just wouldn't believe that this man wanted to get out because he was so successful where he was, and so they said, "OK, go up there

Bainer: and try it and we'll give you a year's leave of absence." And at the end of a year Brandt went down and tried to resign again -- he was doing some consulting for them. And they wouldn't take his resignation. They gave him a raise of pay on their books and extended his leave for another year. They said, "It's going to take you two years to get this out of your system." At the end of two years they found that Harry meant business, and they accepted his resignation so he stayed here. I remember -- of course Brandt had run quite a crew of people, he'd been in some administrative work, and this was the kind of thing he was trying to get out of just like Don Brush and Kemper. Kemper told me that his job with SCM was leading entirely into administration. I remember one day I talked to Brandt about administration. He said, "I came here to get out of all this and all I need to do is to pick up the telephone and return to industry." He was just not going to get tied down with administration here at first. But it wasn't long until he saw the need of people to take responsibility, and now he's chairman of mechanical engineering. This move was very important because Giedt had a very severe heart attack and was laid up for about one year. But you can see how this operation evolved. It wasn't all accident. We had a good show going here, so that it was attractive, and we had people that knew people. And the situation is that bringing in people from industry gave us a balance. This was good because we had two types of graduate degrees. Another break was the offering of graduate degrees. We were giving graduate degrees at Davis through the College of Engineering at Berkeley. When we set up on our own, theoretically I suppose we should have gone to the graduate council and all the way down through channels for permission to give graduate degrees. But the dean of the graduate school said, "You've been giving them so keep on doing it."

We had two types of degrees. We had the master and doctor of engineering which were design oriented, and the master of science and Ph.D. which were research oriented. By having these two types of degrees and I was in hopes that we'd be able to maintain a balance between research and professional engineering, we'd have students coming through both channels. After five or six years, we weren't getting many takers in the professional channel. I think it was because the staff wasn't encouraging students in this direction. It was a more difficult degree to give. All of a sudden at one of our staff meetings one of these highly theoretical assistant professors made a motion that we drop the professional degree. If it hadn't been for some of the people that we brought in from industry we probably would have wiped it out but as it was, there was

Bainer: enough votes to keep it in and now no one wants it out. We're having people coming out in both programs. So this gives you a little picture of things that happened in getting this college off the ground.

During the fall of the fourth year of operation, our faculty decided to apply for accreditation by the Engineering Council for Professional Development (ECPD) which is sponsored by the American Society of Engineering Education and the Engineering Joint Council. And theoretically you couldn't apply for accreditation until you had all four years in operation and some graduates. And here we were, upstarts in a way, applying for accreditation.

Well, the first thing I knew was that Dr. Smith, who was the head of chemical engineering said, "You fellows are wasting your time applying for accreditation, you're not going to get it, and I'm not going to waste my time getting chemical engineering ready." So I said, "OK." So we went ahead without chem engineering. ECPD sent a team of five people here in April 1966. It was a pretty high powered team, I think there were two or three deans. The fellow from Arizona was the only one I knew. They came in on Sunday afternoon and had their own meeting to discuss procedures.

They gave us a thorough review. On the day they came to the campus, ground was broken for our new engineering building. They saw the plans for the new engineering building and they could see that progress had started. After it was all over with this chap from Arizona came in to bid me goodbye and to talk a little bit. He said, "You know, the funny thing-- when we came in here Sunday, this whole group questioned the advisability of a review. Here's a college that hasn't even been in operation four years that is asking for accreditation. But by Tuesday night when they left here you had made converts out of them." Well, you don't hear whether you've got accreditation until the following October.

In October, much to everybody's delight, we got a full six years accreditation without limitations. By then we did have all four years in operation, and had already graduated some junior college transfers. We had a staff of fifty or sixty young Ph.D.s from 30 institutions across the country so you couldn't quarrel with the quality of the staff. And while we didn't have a great deal in facilities they could anticipate, you see, a new building. Poor old Joe Smith was behind the 8-ball, here all the departments in engineering were accredited except chemical engineering, so we had to have a special team come in here the following year and it cost us $200 extra to

Bainer: have chemical engineering accredited. And, of course, they only got five years because that put them even with the rest.

Soon after we started, the students wanted an honor society. So Kemper and Beadle helped the students get organized. You see, you couldn't apply for a Tau Beta Pi chapter for another couple of years. They were smart enough to get ahold of the by-laws of Tau Beta Pi, so they just patterned this new engineering society of Davis after Tau Beta Pi. So, at the end of two years the students applied to Tau Beta Pi for a chapter. The executive secretary and students from all the neighboring campuses, California, Stanford, San Jose, etc., came for the installation. We were expected to give them lunch. Our students didn't have anything in their treasury, so I applied to the Dean Witter fund for the kids, and received $100 to pay for the meal. Otherwise we were all going to have to come through and pick up a check for $100. Well anyway, it went off so beautifully! Everybody was impressed with the facilities, with the students and faculty, and the whole works, and so we got a Tau Beta Pi chapter in two years.

One of the national education groups rate programs in colleges. Of course, Berkeley gets a lot of first and second places, and in some areas for instance in botany, Davis is second to Berkeley in the nation. And, of course, we were just coming onto line when these studies were made. We got mention in mechanical, civil and chemical engineering in the last round. And this surprised everybody that we were in the second group nationwide. So, as I say, everything has just been coming along beautifully.

The growth of our college was phenomenal. The enrollment increased forty-five percent per year compounded during the first four years. And, if you don't think staffing was a problem you were wrong. I had lots of scraps with administration to get staff positions. It's hard for administration to see that you've got to have positions for specific areas in a College. You can't have a man in electrical engineering go over and teach something in mechanical or civil or the like. I'd go into the Chancellors Office, and present our need for staff. If I didn't get to first base, I'd try another way. Finally I said, "Here I just want to show you something. Here's the lineup for fall. These are the courses we can't even teach. We don't have anybody to teach them." Well, when we presented it this way the administration came through with new positions. There were two falls that I didn't know who was going to teach some of the courses -- that's how close we were. I tell you, it was just nip and tuck. But it came out all right.

Bainer: The heavy recruiting was done while we were operating as a single department. This was a great advantage because every recruit had to be examined by everybody. Some people didn't know anything about the recruits field, you know, but they were like I was. They came in and listened to him, and talked to him. We had a group of enthusiastic young fellows around here that could sell this place to anybody. And, of course, we brought most of them out here about March and April when the weather is pretty nice, especially when they still have snow back in the East and Midwest.

Dickman: How did you handle the administration on the promotions of all of these people?

Bainer: Well, all the people who transferred from different departments or different campuses didn't involve any committee action. Appointments of new staff people from outside the university were made on the basis of recommendations from ad hoc committees appointed by the local budget committee. The chairman of the department is not supposed to know who's on the committee. The committee, then, takes all of the material that the chairman can assemble on the recruit for study as a basis for appointments. Of course, after you've been here for a while you know what it takes to get somebody passed on by a committee, so we were very careful. With one or two exceptions, everybody that we proposed got favorable action from a committee. Sometimes they wouldn't bring them in quite at the level we thought they were justified in coming in, but we got them through, and I think this was because of prior experience that Garland and I had on committees. After all here at the university from the time you're an associate professor, you're serving on many, many committees. Sometimes you're even chairman of a committee either for a promotion or an appointment. And I'd even been chairman of committees on the Berkeley campus in the College of Engineering.

There are four things that are considered in an appointment or a promotion. The first thing on the list is teaching ability, and this is probably the hardest criterion to judge. At Davis we've had student evaluation of teachers, and we've paid quite a little bit of attention to it. I mean after all, the students are the ones that are on the receiving end from an instructor, and if they're very favorable that means that the instructor is probably getting across in pretty good shape. And if they have an unfavorable reaction to an instructor they let you know about it,too. Well, we have several ways of judging teaching ability. Occasionally the man in charge of a course will invite others in to hear him, or somebody will audit a course, or have the students in a successive course.

Bainer: For instance, if a man has a student in a basic course such as dynamics, and then the student moves into a course in vibrations, the man in vibrations can soon tell whether he has the basic information he should have. So, there are many ways of judging and it doesn't take long. It takes a much shorter time to find out who are the poorer teachers than who are the good ones. So, teaching is number one. Creativity is number two. And creativity can be determined by research publications or in the case of Kemper who didn't have research publications, by his patents. Or, in the case of one young chap I remember in ag engineering who was on a long, drawn out project that was going to take several years and really did not have a lot to report, and yet he had designed a lot of equipment. When the committee came back through the chancellor to me for more information on this man, it occurred to me that maybe a roll of his design drawings wouldn't be bad to submit to the committee. I sent a roll of drawings of his original design of a machine that was being developed to meet his problem. And they granted the promotion on the basis of this roll of drawings. So you never know, but creativity is very important, and of course this is a thing that many people feel should be rated number one, but in talking with administration on that, I can assure you that they rate teaching number one and creativity number two. But there has been the idea for many, many years, you either publish or perish. And, of course there is something in that, because this is part of the balance. You're supposed to be a balanced individual in teaching and creativity.

The third criteria is professional competence. This is a little bit easier to judge because of outside activities such as in professional societies -- whether or not he holds offices or participates by giving research papers. His outside consulting is also a measure of professional competence. And the fourth is community service.

Dickman: Community service -- elaborate on that?

Bainer: Well, do you take part on the school board, chamber of commerce, Boy Scouts, or church or whatever it might be. I mean you ought to be of some use to the community while you live there. It may be a statewide concern, it may be even broader than just the community, but they want balance in the man. The first two I mentioned are the two most important. All of these are the same criteria that are used for promotions as well as for appointments.

Bainer: When we started to recruit it sometimes took a month to get an appointment through. You sometimes lost people while you're waiting. And especially was it difficult at the starting level, at the assistant professor level. You couldn't wait a month on these guys because there were half a dozen schools after him and the one that could act first probably got him. To meet this situation the rules were changed so that the chancellor had the power to appoint an assistant professor step I or step II subject to later review of the budget committee, but this got people in in short order.

We have within the university an evaluation of non-tenured people -- an assistant professor is not tenured. After a man has been here for three or four years the chancellor either on recommendation or without recommendation of the department chairman can set up a special committee to review his records to date. If it appears to the committee that he is not tenure material (in other words, if there are little hopes of him climbing the ladder) they report back to the chancellor. The chancellor then has the power to write this individual a letter giving them a terminal appointment for one year and this has to be done six months before the end of the school year, so that the man really has 18 months. We had this happen in engineering, and I think it's a very healthy situation because you may have someone that you chose erroneously. It didn't happen many times, but in one or two cases -- Yes I remember two cases where men were given terminal appointments after about three years. They didn't even stay the year. They found new positions. So, it's a little bit hard on the individual but it's the only way you can be sure of building quality on your staff.

Dickman: Part of the professional competency could be judged then by outside consulting activities?

Bainer: Yes, that's true. In engineering -- excluding ag engineering. In ag engineering people are hired on an eleven months basis and they are hired to serve the agricultural industry, and as a result they were not permitted to do outside consulting. In the colleges of engineering at Berkeley and Los Angeles for years and years, it's been a kind of unwritten rule that a man be permitted to consult one day a week for pay as long as it doesn't interfere with his classes and his student relationships. And so they build their teaching program, around a certain day. Now, they don't all do this but it's recognized as a possibility. And this consulting I think is very important. I think to an engineer who is involved in teaching, a direct contact with industry is important. Usually these jobs in-

Bainer: volve design and giving advice on engineering problems. The man that keeps abreast of what's going on in the field is in a better position to give a meaningful course to students because of his outside activities. So that we have some people at Davis that consult regularly, and they consult not only for industry, but they consult for the Army Engineers and other government agencies.

Now in my own case I've done quite a bit of consulting, but this was done on my own time either vacation or in the case of extended trips that I have had like to Japan, England, Chile, or Laos. I just simply went off the university payroll and went onto somebody else's payroll. I had to get a leave approved. In other words, the administration had to grant me a leave without pay, and the regents were always very nice about this. When I returned I was permitted to pay double the amount into my retirement fund.

Dickman: When you were recruiting staff for the new engineering college, how did you get names in the first place?

Bainer: Oh, usually writing to friends, people that you knew, that you had respect for and could trust. You see, a lot of people would dump people, and this is the thing -- you've got to be careful who you get the information from. They won't write a letter that isn't true, but they can state it in a way that covers up a lot of faults. Of course I really got into this recruiting in a big way after I left the department and became Dean of Engineering. We started from scratch. And we hired something like sixty-five men in seven years -- all with Ph.D.s except one. He now has one. And if you don't think we didn't have a busy time. I was on the road fifty thousand miles a year. And I simply went to various institutions, to really top engineering colleges, and just walked in and began to beat the bushes, and that was the only way you could get to them.

Dickman: Would you get nominees from the top and then work down?

Bainer: That's right. I thought, "Well here we are, the University of California." And of course, I felt the name was magic (this was before the student problems of the '60s). So I wrote to the deans of about ten institutions, and I sent a carbon copy to the placement office, and I told them the types of jobs that were open, and something of the salary scale. And I got one reply from -- only one-- Dean Corson at Cornell whom I had met before. He indicated that they had two or three people who were dedicated to teaching. First you had to find someone dedicated to teaching, and this was when industry was

Bainer: picking them all up, you know. So I said, "I'm going to be in Washington, and I've made arrangements to make a side trip up to Cornell." And I interviewed two or three people. One of them that we hired from Cornell, as a result of that first letter, was Charlie Beadle who was in the news night before last. He got first page in the Sacramento Union the day before yesterday in regard to his audio pollution project. It's quite a story, and there've been two TV groups in there to take pictures of the laboratory.

Well, anyway, when we started we had five people we brought over on eighty percent time from ag engineering. They were John Powers, Allan McKillop, Arthur Leonard, M. J. Dvoracek and myself. And this was the nucleus of the original engineering faculty. All of us were in eighty percent time giving a total of four FTE. Of course I talked to this staff staff about going to Cornell. McKillop, who had spent some time at M.I.T., said, "If you're that close, you just have to go to Boston." I said, "I wrote to M.I.T. and never got a nibble." He said, "That doesn't make any difference. Just fly up there and go into the placement office."

So, I went to Boston (Cambridge) on that trip. I went in the placement office of MIT and told them who I was. They had had a letter but nobody had paid any attention to it. They immediately called the head of the electrical engineering department, and I went over to his office. They had two lists of graduates coming out: those who were dedicated toward the teaching field and those who weren't interested and were going into industry. They gave me the telephone numbers; these boys all had a telephone where they could be reached, and I called a young fellow by the name of H. H. Loomis, Jr. He said he could see me at one o'clock. So, at one o'clock I went over to see him. He said, "You're just about six weeks late. I've talked to Professor Robert Saunders from Berkeley (who was the head of electrical engineering) and it looks like I'm going to go to Berkeley." Well, I talked to some others and I even talked to people who weren't going to graduate for two or three years, you know, because this was going to be a continuing thing. So on the way home I stopped, I think, at Purdue and Illinois just to get acquainted. Well, sir, this fellow Loomis apparently just didn't fit the bill entirely in the narrow field that they wanted him for in Berkeley. (I think they found somebody else who fitted better.) Well, they kept this fellow on ice for a month or so. Saunders knew that I was interested in him too, so he called me one day and said, "I was just in contact with Loomis and I had to tell him that afterall, we just weren't

Bainer: going to be able to use him. Why don't you get him on the phone and tell him you can use him at Davis?" So I called him. He said, "Well, I'm going to Illinois to be interviewed, and I don't think I'll go any farther than that." I said, "If you change your mind, just send me a telegram and I'll meet you in Sacramento and I'll pay your expenses out here from Chicago, and we'd like to have you come." After he was in Illinois for a couple of days he sent me a telegram: "Coming in tonight." My wife and I met him and took him out to dinner and he spent a couple of days here. He wanted to go down and see Saunders before he went back. I said, "Perfectly all right." I put him on the bus and sent him to Berkeley. He said, "Is it all right if I talk to General Electric while I'm out here?" I said, "I don't care who you talk to." So he talked to GE and GE paid his way all the way home, so I didn't have to pay his fare home. When I put him on the bus the second day, he said, "You know, when I tried to make up my mind whether to come out here, I felt I was making a wild goose chase. But I've been here a couple of days and I'm just about over the fence. I'm really seriously interested." When he got home he called me up and took the job. He's now the head of our electrical engineering department.

Dickman: You didn't have to do this with sixty people?

Bainer: No, but we had everybody come here. It got easier. You began to get acquainted, you got onto the ropes. I knew very little about recruiting staff. I'd go and find likely candidates in several fields of engineering and of course we could use a broad approach, we didn't have to fill narrow speciality like Berkeley. And I would just talk myself out, on these guys, trying primarily to persuade them to come out for an interview. When they came I didn't talk to them anymore. I just turned them over to my faculty -- the limited staff that I had, and of course, it kept growing. And the fellows here could sell them a bill of goods. And it was better, talking to people his own age, who had experienced working here for a year or so. We built a faculty [laughter], and I still don't know how we did it. Of course, I screened the field. We never hired anybody that I didn't feel would really go over. We operated as a single department of engineering at first. We were hiring people in electrical, mechanical, civil, and chemical. The staff was asked to attend seminars of candidates so everybody came in on the judgement. If we got one dissenting vote on a man we didn't hire him. It had to be unanimous, and every man we hired was a unanimous decision. All of the candidates came here for an interview. Some of them even brought their wives. And we had one or two instances --

Bainer: I remember one couple, I brought them from John Hopkins. (I paid his way and he brought his wife.) Both of them were raised in New York City. They landed in Davis and they were entertained by the new chairman of the department; that's when we began to departmentalize. This couple came to me and apologized. They just didn't see how they could live in a little town like Davis. It just couldn't be done! I said, "I'll tell you one thing. If you ever lived here for one year you'd never go back to New York city." He didn't accept the position.

Well anyway, I think in recruiting there has to be judgment; --first, how you react to him. You have to get as much on him as you can from his professors. Then bring him here, and people who could understand him would listen to his seminar. I said, "Be very critical. Ask the most embarrassing questions you can. Really tie this guy down. I want to know how he answers questions." I didn't know anything about most of those fields, but I could judge how he handled himself. I never missed a seminar. How does he handle himself before the group? How does he answer questions? And how does he respond to this, that and the other thing? Garland soon joined me from Berkeley as associate dean, and Garland had had experience at Berkeley, and between the two of us, we just didn't put anyone up that we didn't think had a chance. And so it went. But to go out and hire sixty-five people in six or seven years time is quite an accomplishment.

And then, of course, later on there was no problem in hiring people. Industry had slowed down and people were applying for jobs. By then, we were departmentalized, and then it became the department's problem.

Dickman: Now, in your recruiting and selection, particularly for important positions in the department, did you use the man's research as a gauge to that selection, or did you?

Bainer: Yes, we did. Of course, in many of these recruits, the only research that he had done was his thesis, and in most cases it hadn't even been published. And, of course, you depend upon his major professors to help you evaluate. You bring him here and have him meet the staff and give seminars. You instruct your existing staff that you want to really put him on the spot with questions to see how he handles himself and how he answers them. As far as I was concerned, many of the people brought here -- were in a field that I wasn't knowledgeable in. I couldn't even ask him intelligent questions, but I could tell how he presented the material and how he handled himself in the question and answer period.

Bainer: We also were looking for people who had research experience in industry, and in a very specific case, I'll take the present Dean of Engineering, John Kemper. John Kemper had had a meteoric rise in industry. In the first place he was a graduate of UCLA. He took his first two years at Ventura Junior College and finished at UCLA. And then he worked for a couple of industrial concerns in southern California, which gave him an opportunity to take some graduate work at night at UCLA. UCLA had quite an extensive program, and he was able to get his master's degree at UCLA while he was working full time.

Then he was accepted at a new company, Marchant which is a part of SCM -- Smith-Corona-Marchant Company. He came in there as an engineer, then he became chief engineer and finally Vice President. While he was in that position, President Kerr appointed him to the Engineering Advisory Council which is a group of 22 very successful engineers, mostly graduates of the University of California. They donate their time and their services to advise engineering deans on problems they might have. I always had great respect for Kemper because he could express himself fluently and in a precise manner, and what he said was really worth listening to.

Well, in the spring of 1961, we invite the engineering council to meet in Davis. We presented them with a mimeographed copy of a tentative program for a new College of Engineering at Davis, and went over it in detail with them. They were very helpful. They made some suggestions and I think they were quite surprised. They expressed themselves in favor of the program which we laid out which had a common core for almost three years. It takes at least two and a half years to give students basic mathematics, physics, chemistry, and basic engineering courses like statics, dynamics, fluid machanics, materials, etc.

About two weeks later I received a letter from John Kemper in which he applied for a position in the new College of Engineering. I was floored. I couldn't believe it. I wrote and told him how delighted we were with his interest in our program, but that he should know one thing, that university salaries were not in line with what vice presidents of companies received. He wrote right back. He said, "I must apologize for not making it clear that money is not a factor in my life. I have been toying with the idea of shifting from industry to education for a long time. That was my main object in getting my master's degree, to be in a little better position to get a position in academic circles. I realize now that a master's

Bainer: isn't enough preparation and a doctor's degree is needed." He intimated that if he wasn't able to get a position in the university he would try the state colleges. He felt that he had a lot to offer education because of his twenty years in industry. I found the man was really sincere. So, I went to the chancellor and I explained the whole deal. I said, "Here's the vice president of a company with a very responsible job, very productive, and we need his experience to balance our staff. We need men in applied engineering as well as in research." And he agreed with me. He said, "Put your request in." So, we wrote a request for an appointment, and I felt there was no use trying to go any higher than an associate professorship. I didn't encourage him very much. Well, it was evident that Kemper just wanted to get his foot in the door.

We had quite a struggle in getting him appointed. He was lacking in research publications which were normally used to determine creativity. That's a very important consideration, creativity. On teaching ability, of course -- all we had to base it on was how he handled himself at council meetings. Well we went back in the records and found that Kemper had certainly been creative in that he had made 15 or 16 patent disclosures to his company, which meant he was dreaming up ideas for completely new machines. Very few people have this ability. Well, anyway he was appointed and came in here as an associate professor, and moved along rather rapidly. He was on a nine months appointment. He was planning on getting a doctor's degree on part-time study just like he got his master's degree. So he applied for entrance at the University of Colorado, Boulder. He also applied for a National Science Foundation fellowship. And, he got in at Boulder and also received the fellowship. So he started what appeared was going to be a long, drawn out summer education program. Well, anyway after six years he was entitled to a sabbatical leave. He figured that in this sabbatical year he could do his research and finish up his degree. He spent '68-'69 finishing the work for his advanced degree. He came back here in June '69 with a doctor's degree, and in July he was appointed Dean of Engineering. And you know, you can just think back what influenced you to bring certain people here. I don't hesitate to say that even though I had nothing to do with the appointment of my successor, I felt that here was a man that had qualifications to be a dean. We had several others in our group by this time that were also qualified to be dean. When he rotates out some time in the future there are others in our department that can step right in.

Bainer: We hired a couple of outstanding young fellows. It was really heartbreaking to me when they decided to return to their alma mater after a year or two here. One was Verne Brown from Michigan. He was first contacted a year or two before he got his Ph.D. by Dr. Soohoo, chairman of our electrical engineering department. Soohoo came in one day and told me that he had run across a young graduate student named Brown at the University of Michigan that he felt was just made to order for our thin film work. He began to describe this man, and he said his scholastic record had been straight A from the time he entered an eastern university for his first four years clear through so far at Michigan. I said, "Well, maybe we don't want him. Maybe he's just a book-worm. Sometimes these people that are absolutely straight A students are great scholars, but they don't mix in." "Well," he said, "you didn't let me finish the story. As an under-graduate he was captain of the football team and president of Tau Beta Phi." I said, "Brother, don't let him get away."

He came out here for an interview, and I tell you, when that fellow walked in my office there wasn't any question-- I didn't have to say one word, I just knew we had to have him. The interesting thing was he had indicated that he wasn't interested in industry. He wanted to go into education. We were told that he turned down 44 jobs in industry and other colleges, and when we got him at Davis, I thought "How lucky can we be?"

He had started some research with his major professor at Michigan, and this research has now culminated in a company that builds certain medical analyzing equipment. He being on a nine months appointment, went back and worked with this embryonic company during summers. Well the company started to blossom, and he began to see so much investment in this other side that he just had to terminate here. He's vice president and chief engineer of this company working with one of his major professors who's left the University of Michigan and they're in business. Well when you lose a fellow like that -- even though he said, "I hope I come back to Davis sometime" it's sad.

We brought another young fellow by the name of Allan McDonald in from Purdue. I had interviewed him at Purdue, and talked to all of his major professors. I came home and I said, "You know, we might be fortunate to get this young fellow, but I would imagine in a period of three or four years, Purdue will try to hire him back. I think they want him to get a little

Bainer: outside experience. His major professors gave some of the most wonderful recommendations I have ever heard." But, we hired him.

He came here for the same reason as Brown. He was just enthused about being in the launching period of a new College of Engineering. True to form, about the time he was in the third step of assistant professorship, his alma mater offered him associate professorship with an increase in salary. Well, we just couldn't, at that particular time, give him an associate professorship even though we had him reviewed. He was told that it would be given one year later without further review. But here was a bird in the hand, you see, and it was his alma mater. This had happened in two other instances, a graduate of Texas Tech and the other New Mexico. These were boys in ag engineering that were with us for a while before their alma mater offered them a job.

Dickman: Now, you had a great deal of success in getting grants, also.

Bainer: I don't know that you could say great success. I think the grants of course are mainly to men on the basis of potential, and the fact that we had real quality-- I mean, we hired real quality. Take Loomis, for example, who now heads up our electrical engineering department. The first year he was here (he was from MIT), the National Science Foundation had adopted a new policy of support in what they called initiation grants. This was one of the greatest things that National Science Foundation ever did in my estimation. I let the director know about it and he really appreciated it. Here was an opportunity for a man in his first year -- I think it was limited to his first four years out of college -- could apply for an initiation grant of ten or fifteen thousand dollars. Enough money so that if he wanted to he could hire a research assistant or he could buy some equipment -- support a little research project. Well, Loomis was an applicant, and I think we had seven that year -- I mean seven people had applied. Well, there wasn't enough money to go around and this was the first year of the grant. We were told later that they were only able to give one grant in seven, and we got one grant in seven. Well, Loomis got the grant and it was for two years for fifteen thousand dollars. Loomis got started on a project on computers that was designed to speed up problem solving. At the end of two years he reported back to NSF. Then he applied for a fifty thousand dollar grant to continue the work. This grant was made on condition that the university would make certain equipment available. This equipment would cost about twenty-five thousand bucks.

Bainer: Well, the fact that we had fifty thousand from the NSF made it easier to go to the administration and get the matching fund. And here was a guy that was only three or four years out of MIT with a project well supported. This was the sort of thing we were attempting to do.

PATENTS AND UNIVERSITY POLICY

Dickman: You've spent a lot of time on committee work including the patent board, now what about patents and the money that's derived from them?

Bainer: I don't know what's going to happen on this patent deal. I was on the patent board for nine years. It is appointed by and reports to the regents. Well, first -- the regents have everyone sign a document when they're appointed that they will cooperate to the extent of reporting any patentable idea to the board. It doesn't mean that the patent board is going to accept all these ideas, but they should be reported.

The board meets periodically to consider ideas submitted. Some of the work is done by mail or phone. If the idea is in a field unfamiliar to the board, expert advice from someone in the university is sought. In other words, someplace in the university somebody can answer most of the questions. After the evaluation by outsiders and the board, a decision is made whether or not to apply for a patent. This, of course, depends somewhat on its commercial value.

Well the point is, over a period of years the patent board accumulated a considerable amount of money-- something like a million and a half dollars, and it worried some of us. One of the things that Hitch did the very first meeting the patent board had after he was made president was to discuss what to do with this accumulation. Hitch came in and told the board in no uncertain terms, you've got to find some way to use this money to the advantage of somebody or you may lose it.

And it was suggested then that we turn a guaranteed amount to each campus. At first the board thought of pro-rating it back to the campus in proportion to where the invention came from. That meant that Davis would get seventy-five or eighty percent of it. I was on the board from Davis and I didn't think that would set too well on the other campuses, so I opposed it. I said, "Let's just make it a flat amount to

Bainer: each campus and make it available to the chancellor for the support of graduate research. All that a student has to do is to apply for support through his major professor and expect to get a couple or three hundred dollars." And so this is the way the thing was lined up. Powers, who is now on the board, tells me that it looks like the state administrators are going to wipe it out, so I don't know what's going to happen. It was a good idea I thought. I didn't want to see it go back to the departments where the ideas were coming from. Some of the money does go to the patentees. For many, many years the patentee received 15% of the royalties. This meant that we weren't getting all of the patentable ideas. Some of the early appointees that never signed the document were dealing on the outside direct with industry which was wrong. So, a revision of the division of royalties was made. After the costs of getting a patent was taken care of, and the university takes out 15 percent for overhead, the balance is split fifty-fifty between the university and the inventor. And this has been lucrative for some people. There's some pretty good patents in the university. Some of them have run out. We had two chemists at Davis in the early days that developed a new method for making panathenic acid. The income from that one patent kept the board going for a long time. You've got to have some income to even keep the patent board going because patent lawyers cost a lot of money. Well, it was quite an education to be on that board. We met, I guess at some time or other on every campus of the university. And we dealt with a lot of people. Of course I was responsible more or less for the Davis campus and I was probably the busiest one because we had more ideas coming off of this campus than any campus in the system. Certainly more income from patents.

The people on the board had nothing to do with the licensing of patents. This is done through the legal division of the university and the chairman of the patent board. One thing they tried to avoid was to give an exclusive license to a manufacturer. Otherwise they might lose control of the patent. On the other hand, there were one or two cases where an exclusive license was given because there was no one else to bid and the company just said, "You either give us an exclusive license or we won't build it."

There have been other cases where a company figured they had a large development cost and should have an exclusive, say, for five years. And there's been an instance or two where an exclusive license was extended at the end of five years if everything was going all right. Of course the royalties are negotiated with every deal.

THE PHYSICAL SCIENCES LIBRARY

Dickman: Did you have anything to do with the physical science library?

Bainer: Yes, I would say that I did. One of the things that I had observed at Berkeley was the large number of libraries scattered over that campus. While the engineering college had a library at Berkeley it wasn't by any means complete. The students in electrical engineering had to go over to the physics library which was across the campus. The students in chemical engineering used the chemistry library. There were libraries all over this campus. And this is expensive. It means duplication of books. It means lost time when you go to one and find out the book is somewhere else.

When we built the engineering building we provided space figuring we'd have to have a library -- at least a reference library for graduate students. And of course that meant that we'd have to hire a librarian ourselves and we just didn't have the money. We didn't have the money first to buy the books, we didn't have any money for a librarian, and I just didn't want to be bothered with it. I felt it was inefficient. Then it was announced that chemistry was going to put up a big addition and that physics was going to build in this area. So I started working on the idea of a branch library for physical science and engineering. Well, there was a lot of opposition and rightfully so, because chemistry had already developed a small library. It was not as complete as they would have liked it, but at least they had a library. Physics had a library, and they just didn't want to move into a common library for physical science and engineering. I wasn't getting very far with the idea. I consulted with Blanchard first. He was for it but he said "You'll never get it. There're just too many empire libraries around." I discussed the matter with Chancellor Mrak, and I told him, "Now, we have an opportunity at Davis that will never exist again. We have an opportunity to avoid the pitfalls and mistakes that Berkeley has made. With all this new construction going up, and I think we just have to have a branch library in this area." And he agreed. Apparently he talked to people in physics and chemistry and they all talked against it. I mean really [laughter] there was a division here, and I can see why. I suppose if I'd been in chemistry or physics I'd have said to heck with you guys in engineering. Well, I stayed with this thing and started writing him letters about this thing. I pointed out that our people in electrical engineering would be over there bothering the physics people

Bainer: because they had books that we wouldn't have in electrical engineering. I said "Now we've got a good department of chemical engineering and that means that these chemical engineers are going to want to use the chemical library and they're going to be in their hair." And we found out that they didn't really appreciate us being in their hair.

What happened finally, when they were finishing the lay-outs of these buildings, and I went to Mrak with my last desperate letter. Mrak just ruled and said we'll have a physical science branch library, and that's how it came about. I hope everybody's happy. We're certainly happy in engineering. I thought probably it might be incorporated in one of the other buildings, but he felt that it ought to be separate so that everybody felt that it belonged to all of us. So, it sits out there, a little three story branch library --

Dickman: It's beautiful!

Bainer: Yes, with a librarian that came here from UCLA who started to buy books in engineering and so forth long before we had the building. Now it's in operation.

COMMITTEE ASSIGNMENTS

Dickman: You've been on many, many committees. Would you discuss your observations?

Bainer: Well, everybody knows that the university is sometimes bogged down by committees. Some were very important, like the patent board, for example, or a promotion or appointment committee. I would say that probably it's the democratic way to settle problems, but on the other hand, I think we just spend a lot of time needlessly in committee work.

Somewhere in my files is the number of committees I was on during one year, and it would just floor you. I was spending an appreciable part of my total time. Now, many of these committees meet after hours and that's on your own time, but you usually try to get together about four o'clock and they'll actually run on through the dinner hour sometimes. I can see the need for many of them. On the other hand I think that some of them could be probably disbanded.

Dickman: You had a committee that named buildings and named streets -- did you ever run out of names?

Bainer: Of course, all the main streets in the campus happened to be named by the committee on which I was serving -- Howard Way and West Quad, East Quad and North Quad -- we left those for people we thought ought to have a street named for them sometime later on. We named the street in front of the library for Peter Shields, -- the father of the campus. We named California Avenue runs past veterinary medicine, and we named Hutchison Drive which runs out to the airport. And now, of course, Orchard Road, Orchard Drive -- there have been some new names added recently, but I happened to be on the committee that named most of the streets.

Dickman: How about buildings, and when did they start naming buildings after living persons?

Bainer: I don't know -- it's been rather recent.

Talking about some of the committees that I served on, I, of course, had some difficulty to remember the vast number, but I can assure you that anyone who's been around this institution for as long as I have has certainly had a great amount of committee work to handle. These are not only appointment and promotion committees, but other committees. They may be university or it could probably be of a national nature.

Bainer: As I looked at a list of some of the committees that I've served on, I'm amazed. I have had some national committee work. For example, I was on the Agriculture Board of the National Academy of Science for several years. I was the only engineer in this group and I found it a very stimulating experience. Practically all the people that were involved were midwesterners or from the east coast, and the majority of them were in administrative work in experiment stations -- either director or associate director.

I was also the representative of the American Society of Agricultural Engineers in the Division of Engineering of the National Research Council for about five or six years. Looking on further I find that I was on the machinery committee for the farm bureau. I'm just now completing a three year appointment on the engineering advising council at my alma mater, Kansas State University. I was chairman of the Committee on the Relation of Electricity to Agriculture from about 1950 til 1970 -- twenty years there. Another committee that was very important was to establish applied science in our curriculum at Davis -- with the Lawrence Radiation Laboratory at Livermore, and this committee, of course, was to assist Dr. Teller in setting up an academic program involving the scientists at Livermore. I was chairman of the research committee for the Imperial Valley Experiment Station for about eight or nine years. Some of the local committees, one on the naming of buildings and streets. I had a rather tough assignment for a while as chairman of the personnel appeals committee for the non-academic staff, and while we had only one or two cases come before the appeals group, they were always a little bit sticky.

I've served on the Committee on Honorary Degrees both here and at Berkeley, Soil Compaction, Wild Land Reserves. I also served for a number of years on two university-junior college liaison committees, one in agriculture and the other in engineering. I was involved in both directions, and these committees eventually became a tri-partite committee which brought in the state colleges. This took a considerable amount of time because we met at various locations over the state of California alternating between universities and junior colleges, and every one of these meetings took at least a day.

Another committee that took a lot of time around the early '50s was the Orchard Heater Improvement Committee of the Los Angeles Chamber of Commerce, and this met approximately once a month. I made practically all the meetings because it was

Bainer: in a rather crucial period following the war when we had our first cold weather and smoked up southern California with orchard heaters. The University of California at Davis, specifically ag engineering was the only research group doing anything about it, and so they insisted that I attend regularly to make progress reports, and we talked about some of this before. For about three or four years I was on a Committee on Agricultural Science, which was advisory to Secretary Freeman of the United States Department of Agriculture. This was also a very stimulating committee, in that I was the only engineer with people from other areas including veterinary medicine, agronomy, sociology, animal science, and the usual number of economists. To start with, we met in Washington about once a month, and then the meetings became less frequent. One of the nice things about serving on this committee was that we met at some of the regional laboratories including Berkeley, New Orleans, Philadelphia. We met at the Wood Products Laboratory at the University of Wisconsin at Madison and the Forest Fire Suppression Laboratory at Missoula, Montana, so that we got quite a broad picture of what was going on in the USDA. And, I think we did a lot of good. I mean some of the things that we were trying to do was eliminate some of the small field stations that the USDA had, or to relocate them near the campus or on the campus of a university, in order that the people involved at the station would have adequate library facilities, and have an opportunity for furthering their education in some instances, and participate in an educational program. We certainly recommended that graduate students be permitted to work with some of the scientists in the USDA.

I notice here that I even served on the Education Policy Committee. I was the first chairman of the Education Policy Committee on the Davis campus when we set up a faculty organization, and that also made me a member of the overall state-wide committee which met at Berkeley and Los Angeles. I was on the airport committee at a rather crucial time when it looked they were going to plow up the airport and put it into barley. This committee really had to battle the administration to prevent this from happening, and I think it was a good thing. I served on another rather crucial committee that was set up to study the future of the two-year curriculum in agriculture on the Davis campus. This was headed up by Dr. Briggs, and we came in with the recommendation that the curriculum be discontinued after a certain period on the basis that two-year work was available in the junior colleges. We had served California over a long period

Bainer: of time when it just wasn't available elsewhere. But, it took a little while to phase out the program. And, of course, there was the deciduous fruit packing committee. I've even been on committees to select deans of other colleges. Civil Defense, and Disaster Preparedness and the Cal Aggie Flying Club. I made three rather important trips that each involved a week on the USDA Agricultural Research Service review of the agriculture engineering research programs at Cornell, Colorado State University, and Washington State University.

I was on a committee set up by the National Academy of Science to study the overall College of Agriculture at the University of Georgia. So, you can see that I've had my share of committee assignments and I've never dreaded it. I think I've gained a better picture of how the university operates as well as how the federal government operates in the agricultural area. My latest assignment is a member of the U.C. Statewide Engineering Council.

Dickman: From all of this committee experience that you've had, what advice would you give a chairman of a committee?

Bainer: That's a pretty tough question to answer.

Dickman: In other words, committees have been laughed at, joked about for not getting anything done.

Bainer: Oh, I won't agree with that entirely. I mean, there are a lot of very important committees that do get an awful lot done. When you think of appointment and promotion committees, they're very important to maintain the high standard of performance. Certainly many committees I've served on certainly have done some good. There's a lot of legislative committees right now who are representing a larger group. In other words, a more democratic approach to some of the problems of the university are handled by a senate group or a representative assembly group, and I think that this is very important. But I wouldn't know what to advise a chairman of a committee. He has to play each one of these problems by ear. Certainly I'd say that the important thing is to get participation from the other members of the committee. Chairman always get stuck with writing committee reports as a rule, and then he has to get signatures and it takes a little time. I've been on committees involving people at Berkeley in promotions or appointments where I was the only outsider and once I got a report written I had to run down all the members of the committee to get signatures. One thing that did help was that I was on the Berkeley campus for two days a week for half a semester during the spring, and that's when it seemed like committee work was heavy.

CHILE, 1958

Dickman: Your biography shows that you had been a consultant in Chile. What were you doing there?

Bainer: My first trip to Chile was made in 1958. I served as a consultant to the Food and Agriculture Organization (FAO) of the United Nations. This organization had one man stationed in Chile (Lars Stenstrom) who helped to organize a school. He was assisted by Fred Meyer of ICA. My assignment was to be co-director of a six week's school, and this school was to be held at the University Concepcion agricultural branch which was located at Chillan, Chile. It reminded me a great deal of the Davis-Berkeley set up, where the University of Concepcion was located on the Pacific, and about seventy miles toward the interior was Chillan, which was the agricultural school. The other director was a local man (Guillermo Simms) who was the head of the agronomy department. They did this because they wanted to tie in the local school in a very substantial way so that the two of us then were co-directors. Well, this school ran for six weeks. We had instantaneous translation, English and Spanish, and this was my first experience, and I'll tell you, it was great. We had an interpreter by the name of Etcheveria. He had an advantage I suppose over the other similar interpreters in that he had an advance copy of each paper. All papers were prepared in advance, translated into Spanish, and mimeographed.

The participants came from ten countries in Latin America. There was a total of about forty-five people. They were people that were working in mechanization within the various countries of South America, and they were sent there by their governments. The FAO paid their way to Chillan, paid their expenses while they were there, and their own country had to pay their way home, which is the way it was financed.

By holding this conference out at the campus of the ag school and housing everyone in dormitories, we had a pretty good control over the group because we were far enough out of town that it was too much of a walk for them.

We planned a program of lectures for four hours every morning. This was from eight-thirty to twelve-thirty. And then at two-thirty we spent three to four hours with field demonstrations. The point four program (ICA) had shipped in a lot of machinery. It was probably too much machinery to absorb at one time, but nevertheless machinery was available.

Bainer: The local FAO people arranged all demonstrations. Then we came back for dinner and a little period of relaxation, and then after dinner we had films that we ran for an hour. So it was a long, long day, but I can see the value of it because we kept these Latin Americans busy from morning to night, and I think if there'd been idle time we probably would have lost some of them. That is they would have run out on us.

Dickman: It was all male?

Bainer: All male, yes. Well, this went on for five weeks, and as I say I think it was quite successful. We had local people that were qualified to talk about their projects, and I gave a series of lectures on everything from rice to sugar beets. A man from the U.S. Forest Service (John McCool) gave lectures on maintenance of equipment. I might say that that was the least appreciated of anything we gave. It was awful hard to keep the group interested in maintenance, involving lubrication and machinery adjustment. And we had some people there that were qualified in the irrigation area. One was a Cuban (Jorge Camacho) that had (this was before Castro) graduated from the University of California actually in irrigation. He gave a tremendous series of lectures in irrigation, and spoke the very best Spanish of any group they had.

I failed to mention that FAO sent Harold Kitching and Betty Carter from Rome to handle all details including financial for the school. Jack Connors of the World Bank was there to discuss development loans.

Well, as these lectures were given, if they were given in English, the translation was available instantaneously in Spanish and vice versa.

Dickman: Earphones?

Bainer: Yes, earphones, and all you had to do was switch from one to the other and you got it in either English or Spanish.

At the end of the formal program at Chillan, it was decided to take the whole group to the south tip of Chile known as Magellanas which is on the Strait of Magellan. We flew the group from Santiago non-stop to Punta Arenas. Arrangements had been made to bus this group north about four hundred kilometers to the headquarters of a large ranch (Estancia Cerro Castello) operation -- one of the headquarters. This headquarters was under the direction of a Scotsman by the

Bainer: name of Saunders. We spent three days on this ranch observing some reclamation. When I heard that this trip had been arranged (I had nothing to do with it), I thought it would be a wild goose chase. It was something like fifteen hundred miles down there. But, after we got on the ranch and began to see the operation, boy it was really very worthwhile.

This ranch was on fairly level land except for a mountain range extending to elevations of 10,000 feet on the east side. There were glaciers on these mountains. The ranch extended for miles. It contained four and a half million acres, which is four and a half times the size of the King Ranch in Texas. We think that's a big ranch. This one headquarter was running a million and a quarter sheep all for wool production. They were reclaiming land from the brush and planting it into permanent pasture. They had three rainfall belts on the ranch. The rainfall varied from 15 inches to 30 inches as you moved over the ranch. So, they had three types of brush. In the 15 inch rainfall area, they had sagebrush. This could be plowed under with disc plows, and that's what they were using. They had six Caterpillar tractors with John Deere 5-bottom plows. They covered a lot of land in a day. I made a remark for which I was sorry afterwards because it was misinterpreted. I told them that that was about the roughest job of plowing I'd ever seen. It really wasn't turned over very well. Well, the manager took me to a high point and showed me a lush, green pasture which we eventually went down to see that was only four months out of the brush. And I was embarrassed because it was so beautiful. He said that their problem in getting a pasture started was the birds (water fowl) eating the grass. You never saw such flocks of ducks and geese in your life as they have down there. It was fall and they were about ready to migrate. I made the remark, "This would be a paradise for a guy with a shotgun." "Shotgun, we don't shoot these with shotguns! We use revolvers." [Laughter]

In the intermediate rainfall belt, they had a brush known as mate negra. It grew about table height and was thorny and very brittle. Well, you just couldn't pasture it. It would pull the wool right off of the sheep, walking through it. They said it took two or three acres just to support one sheep. They were rolling this material down and breaking it up with Corpus Christi rollers made in Texas. It was simply a huge roller that weighed maybe five tons, and it had six radial blades. They just hitched a big tractor on the front of them and rolled right over the top of the brush. This broke the

Bainer: brush down and the knives had a tendency to cut it. Some was uprooted. As soon as the brush was dry they fired it, and boy, I guess it must have been a hot fire because they got a complete burn. I saw some of this just after it was burned. Only white ashes were there.

Because of the high winds they have to be careful the time of year that they burn, and also they've got to work pretty fast to get it re-seeded, otherwise the wind will just pick up this dry soil and ash and carry it away. They were in there just as soon as the ashes cooled, with a mixture of grass seeds. I failed to mention that they had an agronomist that I found was quite world renowned by the name of Mario Habit, who had searched the world for grass seeds that he felt could be used on this particular ranch. And he finally wound up with a mixture of four different grasses. One was alfalfa I know, and one was I think orchard grass, and one was white clover, and I forget what the other was.

He was having marvelous success in establishing pastures where the brush was. He also set up a little experiment station where he actually compared all kinds of grass.

Well, the third rainfall section of this ranch, 30 inches, had a brush that grew fifteen feet high. They were taking care of that with tractors with bulldozers. The brush was bulldozed into huge ricks. Grass was immediately sown between the ricks. Then a year or so later the ricks were burned and that area seeded. They were reclaiming several thousand acres a year, and improving their carrying capacity of the pastures.

The sheep were sheared there on the ranch with modern shearing equipment. They'd bring in sheep shearers during the shearing season. All of the wool was purchased by firms in England. When the shearing took place their buyers were there to grade the wool and see that it was properly sacked and tagged and shipped straight to London. This ranch, of course, extended out to the sea. There was a small harbor that would take ocean going ships within 3/4 of a mile of the shearing shed. They also had a slaughter house and freezer, and were harvesting some of the sheep. They were also running about 16 thousand head of cattle on that operation.

Dickman: What kind of sheep?

Bainer: They were shropshires, I think. I'm not sure. They weren't purebred. They were a hearty race. I think they had brought

Bainer: breeding stock from Scotland. One thing I noticed that they fenced out all the high elevations to keep the sheep off the steep slopes, otherwise their feet would work the soil and loosen it up and the wind would pick it up and take it away. Actually, we didn't have much wind until the last day we were there and then the wind really whooped up. You could look up at the top of these mountains and see the mountains actually moving, because the dirt was being blown up one side and being deposited on the other side.

They had tremendous fishing. I saw one German brown trout that was brought into the hotel. Someone had caught it and brought it in to have it cooked. It weighed 35 pounds. [Laughter]

Eight of us stayed in Saunders' home. He had it fixed up for guests. They had four bedrooms with twin beds with a connecting bath between each pair. I'll never forget that first night we arrived. The manager came down and met the bus about half way between the ranch and Punta Arenas, and picked some of us up. We got to the ranch early, and the man from FAO who was looking after this trip felt he should stay with the participants. And so he was delayed in getting there. He was also going to stay at the house. The students were put up in the sheep shearers quarters. I was a little concerned. I felt that maybe this was a little bit of discrimination so I went down to see the quarters where the students were going to stay and I found out that they were very nice. They had a club room and their own dining room.

Well, to make a long story short, we waited until our whole group was there before we went into dinner. This was twelve thirty midnight. Eight guests with the manager and his wife, one sitting at each end of the table. Each had a standing rib roast that would stand at least ten inches high, and each carved off enough for the four at their end of the table. Two servants served the table. After dinner the manager wanted to bowl. We had flown 1500 miles that day and had driven four hundred kilometers, and [laughter] had dinner at twelve thirty midnight, and after dinner he wanted to bowl!

Well, it was a magnificent trip, and I'll tell you it was an eye opener, and what feeds we had down there.

Dickman: What time did you ordinarily eat?

Bainer: At eight to nine o'clock, even in Chile, but there was one thing I must mention. We had an asada, which is a barbecue, the last day we were in the field. They barbecued ten lambs

Bainer: on vertical spits that were near a big log fire. Fifty men including the crew from the ranch, cleaned up the 10 lambs. I have pictures showing these ten lambs before and after. Boy, I'll tell you, there was wine, boiled potatoes, lamb and bread, that's what we had.

Dickman: What was the average age of those students?

Bainer: Oh, I would say 35 probably.

Dickman: How long did you stay on that trip?

Bainer: It was just three weeks. I've had two other experiences in Chile. We'll cover those while we're talking about Chile. While I was moving back and forth to Peru on another project, the Rockefeller Foundation found out that I made these periodic trips and they asked me if I could come down for a short period to advise them on some research in the field of agricultural engineering that might be started in Chile. I actually was going to Peru for FAO, and I felt I should get permission from them to extend my trip to Chile which I did, and this was in 1962. They said I could do it provided I would give them a copy of my report.

Well anyway, I went down there and I spent time with Art Leach who was their agricultural engineer. He was responsible for the development of facilities for two experiment stations, one at Temuco, which is 600 kilometers or more south of Santiago, and the other near Santiago. After spending a week with him I made a report as to what I felt was needed in the way of research and left it with him. He was pulled out of Chile soon after I was there and sent to Africa, so I'm sure my trip was a lost cause.

In 1964 the University of California and University of Chile received a grant of $10 million from the Ford Foundation for an exchange program between the two universities over a ten-year period. And the idea of the grant was a two way street, in other words, professors from any campus of the university could go to Chile for a year, or less. A lot of them went for less. Personally I felt that they couldn't do a whole lot in much less than a year. Professors from Chile, that had qualifications, could come to the University of California at any campus (depending upon their specialty). There was also a two-way street for graduate students, Chileans could come here and study and American graduate students in certain areas could go down and study for a year. This was really a magnificent project, really, and I was surprised how fast it

Bainer: was put into operation. I thought it would be difficult to get people to go for a year, but we had a waiting list.

There were some areas where we didn't get very good cooperation and we just kind of ignored them, but there were other areas where things developed pretty fast. For example in engineering, I suppose the most outstanding project we had was in earthquake engineering. Professor Martin Duke from Los Angeles headed up that program. He actually went down there and had other members of his staff down and then people up here, and some graduate students. That was just typical.

I'm out of touch with the project now. I stayed on that committee for the first five years, and in '69 when I retired Dr. Hitch asked me if I would continue on the committee, but I got involved with other consulting deals, and I wasn't able to participate, so I was dropped from the committee in 1969.

Dickman: Is the project still working?

Bainer: Yes, it's still working and we have people from Davis who are down there.

Dickman: Right now?

Bainer: Right now. I would say in veterinary medicine, agriculture, engineering, things went along pretty well, but when you got into some of the humanities it was a little difficult. Actually there is a real problem in Chile under the change in administration. So I don't know what will happen.

Now, for one of the most outstanding contributions. The physicists at Davis had built a twenty inch cyclotron and had it operating. Then when the big 60 inch cyclotron at Berkeley was going to be junked, they asked to have it transferred to Davis. It was enlarged to seventy-five inches. That meant that the little twenty incher wasn't needed anymore. And so they got permission from AEC to transfer the 20 inch cyclotron to the University of Chile. In preparation for it, they sent people from Chile to Davis to learn how to operate it. Then the crew that disassembled it marked it so it could be shipped to Chile and re-assembled.

Chancellor Mrak and I attended the dedication ceremonies of that cyclotron in '68. Edwardo Frei, the former president of Chile, was there. They had built a new building on the outskirts of Santiago for the placement of this unit, and they had begun to dream up all of the uses that they were going to

Bainer: put it to. So this was real constructive. I would say that the Davis campus, because of physics and agriculture relationships had more going at the University of Chile than any other campus -- even though there were exchanges in chemistry, mathematics and physics between other campuses.

So, this kept me in and out of Chile from '58 to '69 -- around eleven years.

Dickman: Did you speak any Spanish at all?

Bainer: Well, naturally you pick up some. I took the Spanish newspaper. I did it just to practice reading. I find that I can read Spanish better than I can speak it. I did take the night course in conversational Spanish at the high school for a year. But unfortunately it came at the time we were developing the engineering college and I was recruiting in the field so much, and also had the project in Peru, so I don't suppose I attended half of those classes. But I did practice Spanish in my hotel room at night while I was away. I got quite a bit out of it. Most of the places where I worked everybody I dealt with spoke English, and they wanted to practice their English with me. It is certainly easier to talk in your native tongue if the others can understand you.

Dickman: Do you know where the Ford Foundation got this idea of the combination of Chile and the University of California?

Bainer: The idea originated with the Latin America studies group at UCLA. Frank Murphy, formerly chancellor at UCLA, was the original overall chairman. Prior to this, there was a cooperative plan between California and Chile at the state level. It was supported by AID[2] but did not involve the universities. After a couple of years the plan was cancelled due to the lack of worthwhile results. It was after that that UCLA and the Ford Foundation got together on a five-year plan that was soon extended to 10 years. The problems they're having in Chile now with its changing government makes it harder to operate.

Dickman: You had more than one country in South America in which you consulted I believe, did you not?

Bainer: That's right. In Latin America I've been in five countries, but in South America proper three. The second country involved here was Peru. And again I'll have to back up just a little bit, to Chile, because before this school was held at Chillan, FAO tried to interest Chile in a professional

[2]AID is Agency for International Development

Bainer: program in agricultural engineering at the University of Concepcion. I was invited to go down there and take a look at the setting up of such a program, but I was in a very busy period for me and I just couldn't spare the time. So, I had to turn the thing down. They sent Professor C.G.E. Downing from Guelph Canada. He developed a program which the Chileans never accepted. By that I mean they were unwilling to put up half the money. In other words, the FAO agreed to put up a certain amount of money if the Chileans would match it. And after a couple of years that thing fell through.

ADVISOR TO SECRETARY OF AGRICULTURE

1961

Dickman: During 1961-64, you served a total of three months as advisor to Secretary of Agriculture Freeman. On the Committee on Agricultural Science. Is that correct?

Bainer: That's right. In 1961 I received a letter from Secretary Freeman, asking me if I would be a member of an advisory group to him. It happened right when I was leaving agricultural engineering to move over into engineering as a dean with responsibilities to get the College of Engineering off the ground. So, I wrote to Secretary Freeman and I explained that I was no longer directly involved with agricultural engineering, that I was moving to this new position, and possibly he'd better get somebody else that was more active in the field. And so I didn't accept, you see. I thought, "I'll wait a while and see what he comes back with." So in the meantime, I guess it was -- oh, a month went by, I suppose, and I was in Washington for a meeting of the National Research Council, and I was on this council for about seven years. One of Freeman's right hand men, T.C. Byerly,came to me at that meeting and he said, "Are you going to join us or not?" I said, "Well, I never heard anymore from Freeman." He said, "He definitely wants you and we want you regardless of what your position is. We want you for your experience and background. We've got to have some help right now and it's all going to be based on people with background experience." So I told him I'd do it.

This committee was made up of about three or four economists, an agronomist or two, an experiment station director, a sociologist, a veterinarian, and an ag engineer. I was the only engineer on this committee and sometimes I felt that I was outvoted. And well anyway, I think there was about ten or eleven of us.

Dickman: That's a very interesting mix.

Bainer: Yes, a very interesting mix, but more economists than anything else. And so we had our first meeting in Washington and we elected Will Meyers as chairman of the committee. Meyers was from Minnesota. He and his brother both went to Kansas State just after I went through there. His brother is the dean at Arizona. Meyers had been in plant breeding and later ended up as vice president of the Rockefeller Foundation, and just died about six months ago. Will Meyers was a very capable

Bainer: leader, and a good organizer, and he kept the committee on the track all the time. He was the liaison between the committee and the Secretary. And everytime we went to Washington the Secretary always came in and talked to us and visited with us.

Well there were so many problems in the Department of Agriculture that we found ourselves going to Washington once a month for about a two-day session each time.

Dickman: For how long?

Bainer: Oh, this went on -- well, for the first year. Then we began to slow down, and I thought, "Boy, this is really going to take a lot of time." Here I was trying to get an engineering college off the ground and every month I had to make a trip to Washington. We usually went in on a weekend so that we didn't lose anytime travelling one way at least, and we came home in the evening after the meeting and so it was just the two days. But after all, two days out of the month.

We were presented with many problems. Most of them were budgetary and some of them on organization. Some of them had to do with promotions of people who didn't have responsibility other than for research. They didn't have anybody under them. It was something like the old system we used to have here. If you were a technician you didn't get promoted unless you had some technicians under you.

Well, I of course was responsible for the ag engineering research. So I got them to appoint a subcommittee consisting of Orval French from Cornell, Erv Schroder from Oklahoma, Price Hobgood from Texas A and M, and Dick Frevert from Arizona. We had a special meeting in Washington and reviewed the agricultural engineering research with the idea of making recommendations. And this, of course, gave us an opportunity to really delve into problems. The USDA ag engineers really brainwashed us on some of their problems that they weren't able to take care of. And we also saw some places where improvements could be made. One of the things of course that came out of our subcommittee work was the fact that their research people just were not financed properly. They didn't have really enough financing available to do the utmost in their research.

Furthermore, as I mentioned, some of these people got to a blind alley as far as salary was concerned. They got up against a wall and they couldn't go any further. These had to be corrected.

Dickman: Were these USDA people?

Bainer: Yes, all USDA people. We (the main committee) made ourselves popular in some respects and unpopular in others. For example, we suggested that many of the small field stations that the USDA had around the country be closed or moved. We didn't just say close them and fire everybody, but to combine them with an agricultural experiment station in the state university system and move these people near educational centers for several reasons. We felt that they should have better library facilities available to them, that they should have educational facilities available to them. Many of these people needed more education. They needed another degree if they were going to go up the ladder. Many of them held just bachelor of science, and they certainly could benefit from a master's experience or even a Ph.D. We felt that these people that were qualified should be appointed as associates to existing staffs in the university, and be available to help teach certainly at the graduate level -- taking graduate students into their research program and give the graduate student an opportunity to do some basic research in an area where he could be supervised.

Dickman: Would this recommendation affect a station like Shafter?

Bainer: Well, probably not, because Shafter is more than just a small station, and Shafter is serving a definite industry like cotton. You have to have a station like Shafter in a cotton region because you have breeding and production problems. No, I wouldn't say Shafter, but take the old experiment station we had at Amarillo Texas that I worked on. Of course that did disappear, but there are other small stations here and there. Well, you know what happened. Those recommendations went into the congress that they were going to close the station in a particular area and the congressmen from that area went in for a larger appropriation to make a big station out of it. I mean it was ridiculous. The politics that you run into. This has just got to be funny, actually. We'd make a certain recommendation and there was always somebody that killed it. The point was, you see, that the competition for money in the federal government is getting keener and keener. And if you go back in history you'll see that agriculture at one time got the lion's share of the money from the government for research and development. The percentage now that the agriculture gets is going down, and down. And, it's beginning to just get insignificant as a percentage of what goes into everything else that the government's involved with. I think it was less than five percent. I mean it got

Bainer: down to the point where you just couldn't operate properly.

Another thing that the committee got involved in was the regional laboratories. See the USDA set up laboratories in various regions to serve the problems of the regions. There is a laboratory still at Berkeley. As far as I was concerned that laboratory should have been on the Davis campus. They've got lots of excellent scientists there, and excellent equipment. They're working on problems that are typical of this area, one of them being rice and rice by-products, new foods made out of rice. And they're doing a lot of rather basic work.

Well anyway the committee decided first that we'd visit some of these laboratories and have our meetings there, and so we had a meeting in Berkeley, and that was close to the laboratory. We held a meeting in New Orleans where the laboratory was involved with fibers and local problems, sweet potatoes and things like that -- by products. We met at the laboratory in Philadelphia. We met in the laboratory for wood products at Madison, Wisconsin which was right on the campus. That was one laboratory I felt that was properly located. We went to the fire supression laboratory at Missoula, Montana, and that was a real education, to be filled in with a description and results of what they have accomplished in fire fighting in forests with smoke jumpers. When there's a little whiff of smoke coming up, they fly a guy in there and drop him with a parachute and a shovel. It was just amazing how they had stopped many of these fires practically at the source.

Dickman: Did you talk a little about spark arresters?

Bainer: Yes, this was the funniest thing. You know, we had a prepared program presented to us. We were told what they were doing in the laboratory. One of the men gave us a talk on some of the problems of the forester. He was in forestry school at the university there at Missoula and worked at the laboratory during the summer. His name was Francis Lory. When I got his name it struck a bell with me.

After he was through with his talk I went up and I said, "Are you from the family of Lorys at Fort Collins, Colorado?" I said, "Was your father president of Colorado State University." He said, "Yes, that's right." Well, it so happened that my father was also on the staff there for four years and we lived across the alley from the Lorys. As little kids growing up, we played together. And when I told him who I was, the first thing he said to me was, "Can you remember when you and

Bainer: I used to sit on your front porch every night to watch Halley's comet go down over the mountains." And that was the period we were talking about -- [laughter] when Halley's comet was visible.

Dickman: 1910. You were eight years old.

Bainer: Yes, I was just a kid. Anyway, we had a nice visit and he asked me where I lived. I said, "I was at the University of California at Davis." There were two young fellows helping him with his demonstrations. He put on a demonstration and talked, and these two fellows came up and said "I understand you're Roy Bainer from Davis?" I said, "Yes." He said, "Do you remember a spark arrester bulletin that you and Fairbank wrote?" I said, "I sure do." He said, "Do you know, that's our bible. We know from the results of that bulletin that -- when we've got a fire hazard, you see. You started fires under enough conditions and reported all these conditions and they're not any different here." Here were a couple of young fellows saying that was their bible. [Laughter]

Dickman: How about the hose? Any mention of that?

Bainer: No, nothing was mentioned there. And of course, they were more interested in how these fires started, you see, and getting to the fire without letting the fire get away from them. This was a rather interesting experience. Well, coming back to the committee, we met at some of the other institutions. We met at the University of Arizona. One of the members -- an economist on this committee was from Arizona and so we met down there. It was nice to go down there about February for a meeting and we didn't have any trouble getting the committee to attend.

Well anyway, it was an educational experience, let me say. I don't know how much good this committee did, but we certainly took up the problems that came up -- salary scales, promotions, and research activity. We suggested a super grade for people that were top scientists you know, that were up against a stone wall -- that couldn't go any further salary wise. But when we suggested closing stations, that was more than the congressmen from those districts could take.

PERU, 1961

Bainer: One of the chaps that was at Chillan from Peru for the mechanization school was a young professor by the name of Guillermo Carrera. He was one of the few people that came to this school that spoke good English, so naturally I probably got better acquainted with him than the others because we could converse. He was a very friendly chap. He had gone to school at Michigan State.

When he heard that FAO had made this offer to Chile he went to his administration at the Agrarian University of Peru which is located at La Molina, which is about six or seven miles southeast of Lima, and told them that he thought they should look into the possibility of a cooperative program with FAO which they did. And well anyway, the FAO made an agreement with the government of Peru in which FAO would put up about a half a million dollars and the government of Peru would match it. Then they proceeded to look for someone to come in as a consultant to develop a program in agricultural engineering. So, I was invited to go down to La Molina by FAO in the spring of '61. It was for the purpose of setting up a professional program in ag engineering. When I arrived at La Molina, I was met by the director whose name was Bacerra and the dean of the faculty which was really a mechanized agriculture faculty, but they called it ag engineering, Carlos Vidalon. Bacerra had a doctor's degree from UCLA in subtropical agriculture. Vidalon had a masters degree in civil engineering from the University of Minnesota, and had spent one year with the Bureau of Reclamation before returning home. So here were two people educated in the United States.

Lars Stenstron, former FAO representative in Chile, now in Rome met me in Lima. So the four of us got together. My feeling at the start was that they weren't ready for a high-level, professional program. And, I remember our first conversation. I made the remark had they ever considered the San Luis Obispo approach to a real practical, down to earth program in agricultural engineering. Both Bacerra and Vidalon had been in San Luis Obispo. Bacerra said, "We brought you down here to develop a program that is just like the one that you have at the University of California. Eventually we will put in a mechanized agriculture program like San Luis Obispo, but we're going to start with the very best program we possibly can dream up, and that's what you're here for, to lay out that kind of a program."

Bainer: I said, "Well, I can lay out that kind of a program, but how it'll be implemented is beyond me." Because I knew by this time, you see, that there were great limitations in his staff. No one was really a graduate engineer, and how are you going to turn out anything like a professional program.

Well, I took them at their word and I laid out a five-year program. They had many university and college requirements. By the time I worked all those in, the professional program came to about 200 semester hours. Well, this was fine. If you looked at their catalog, all programs had 200 semester hours. 20 hours a semester. Well it just sounded ridiculous to me. I said, "It's just too much for a student to try to carry 20 credit hours per semester." They pointed out that the student had to spend more time in the classroom with their instructors because of the lack of textbooks. He said, "We're just not as efficient as elsewhere." Well anyway, I set this up with 200 semester hours which required five years. Then I began to worry, "Who's going to teach certain courses?" The math and physics and chemistry wasn't really at top level. It wasn't comparable to what we insist in having for our program. And there wasn't anyone there who could teach statics, dynamics, strength of materials, fluid mechanics, thermodynamics, etc. I was in a real sweat. You can lay out something, but how in the world are you ever going to get this thing off the ground? I told Rector Bacerra, "I'd like to talk to the people in the University of Engineering." Unfortunately it was not located close by. It was clear across on the other side of Lima. So he took me over there and I was introduced to the Rector of the University of Engineering. They had a very good school. I told him that the Agrarian University was considering putting in a program in agricultural engineering. Well, agricultural engineering to him meant ingeniero agronomo -- everybody was an ingeniero agronomo down in South America, and it wasn't a high-level technical program at all. He didn't show a whole lot of interest. Finally I said, "Would you like to see the type of program I've laid out?" So I laid out the sheets showing each semester of work. He went through the sheets and said, "Well I would never have dreamed that you're going to try to develop a program like this." This really meant something. He said, "This is engineering." I said, "Yes, it is." I said, "We need some help."

Well I never saw a fellow who as a result of one conversation, turn around so completely. He said, "I want to take you around. I want to show you what our facilities are." They had some very fine teaching laboratories. They had a beautiful set up! He said, "You can use any of these laboratories with your

Bainer: classes. It'll mean you have to bus them over here. Also we probably have some of our instructors that would be very glad to teach in your program." Salaries are low down there and pretty near everybody held two jobs. Well, we lined up people to teach statics and dynamics, basic electricity, etc., from the College of Engineering.

Well another very important thing happened. The North Carolina State University at Raleigh had a contract with AID to assist in upgrading the Agrarian University. This was a surprise to FAO. They didn't know anything about this arrangement. They were to come down to help improve or raise the level of instruction on the campus, to design a complete new campus, and to improve the handling of records. So when I went back to La Molina the next trip, I ran into these North Carolina people. I didn't even know they were coming. And, as I said, FAO hadn't been informed. I thought, "This is just the end of our project. Here's a big university coming in here. They're strong, they sent three or four people in and they've got AID behind them." They put me at ease immediately. They said,"Mr. Bainer, we've seen the program you've laid out for ag engineering, and this is great, and we're not going to have anything to do with it. All we want to do is support you in ag engineering. What can we do to improve your program?" I said, "Well, you can help by strengthening the program in physics, mathematics, and chemistry in the College of Arts and Sciences. So they proceeded to do this, and they left us completely alone in ag engineering.

Well, in planning this program in ag engineering we decided to bring in five experts, one in each area of agricultural engineering -- machinery, structures, soil and water, food engineering, and soil conservation. I didn't want the latter separate from soil and water but they insisted on it. Later we combined it with soil and water.

Well, of course, the problem was to get people qualified in those areas there for five years. This was a five-year program. We didn't succeed in getting one single person from the United States. All these people came from Europe. The first two to arrive were Godinache from Belgium, an irrigation specialist, and Berlijn from Holland in farm power and machinery. They arrived in January '62. I also made my second visit then. These two people were, of course, unfamiliar with the type of program that we have in the United States. It was so foreign to them that they were positive that it wouldn't work. And, unbeknownst to me, the two had sat down behind my back and designed another program. Finally they began to argue with me. I went to the Rector and I said, "You know. Godinache and

Bainer: Berlijn are overhaulling the program that I set up and I want you to know that it's probably best for me to just bow out of this." I never saw anybody get so riled up in my life as that Rector! [Laughter] He called those two fellows in. He said, "Last April we had Professor Bainer here from the University of California. He laid out exactly what we want, and if you fellows can't implement it, we'll get somebody in here who can, so just forget what you're talking about." Oh, I tell you, he just read them the riot act!

After four months the university asked that Godinache leave. The boy from Holland was a little smarter, and began to see merit in the new program. I have some prize letters, copies of letters that he wrote to the Rome office of FAO. One of them said, "Do you know? It's just unbelievable that Mr. Bainer designed a program in two weeks, while Godinache and I worked on one for a month or more and couldn't get acceptance." Joe Berlijn was his name. He had to take over as acting director when the Belgian was sent out of the country. The experience had been upsetting because after all I knew I couldn't get along with the Belgian. He was impossible. Nobody could get along with him. That's why they got rid of him. The Dutchman warmed up after a while, and of course, after it was all over with, I tell you -- he was very proud of the program! The last remark he made to me five years later was "What I'd give to lift this program up and set it down at Wageningen in Holland and show them how to run an ag engineering program!"

Well anyway, the program grew. I made periodic visits. They brought in another Dutchman by the name of Karel Goossens for the soil and water area and an Englishman by the name of Frank Low in soil conservation. They brought in a Frenchman by the name of Marc Pons in food engineering, and here was another misfit. And after a few months they unloaded him. The whole thing started to go, and enrollment was heavy.

They started to strengthen their programs in math, physics and chemistry, and the professors from the college of engineering started giving the basic engineering work. Of course the experts could do very well in their areas. The man that headed up structures was a graduate architect from San Marcos University and a very capable man. Not too practical, but certainly knew structures. We never did get a real expert in there for any length of time, but we did bring a man named Corrado Ricci, from Barre, Italy, who just hit it off with everyone. He was in there two or three times for shorter

Bainer: periods and did a tremendous job. We brought another man in H. A. Leniger from Holland in the food technology area -- a short-time assignment, and he did a whole lot for them. In fact he sent two of his graduate students (Albert Ros and Hernan Barreto) with complete equipment for a units operation laboratory. They stayed there for two years and got the laboratory set up and started some research. Two other short-term consultants from the United States were Dan Brooker from the University of Missouri in engineering analysis and L. L. Boyd from Cornell in structures. I tell you, things began to move much better than we had anticipated. Well, we had a deluge of students! It was just unbelievable the number of students that enrolled in that program! Starting with 73 students the enrollment jumped to 423 five years later.

Well then we began to worry how many could make it. After all, this was a pretty tough program. About the third year, I think, we put in a bridging course in mathematics. We still weren't getting enough mathematics in the regular courses to prepare a man to go into the engineering subjects. So we put in what we called mathematics for engineers. This mathematics course was to be the screen, and anybody that couldn't pass this course couldn't go any further in the program. He could go back and take some more mathematics and come up and try it again. But this was the end of the line if he couldn't pass this course. Half of them couldn't pass it. So that meant, "What are you going to do with this half?" You couldn't just throw them out on their face, so there's where the mechanized agriculture program came into the picture immediately, you see.

Bacerra and Vidalon were much smarter than I because they saw that they would have to do something with the people that couldn't make it. So we put in a right hand turn for students who couldn't handle the professional program in a course in mechanized agriculture. They probably needed ten times as many of those people as engineers at this stage. So, this phase began to work.

The program just kept snow-balling. I'd go down there periodically, and I spent at least two weeks. I'd review each one of the groups, and make suggestions for improvement. Then I'd have my complete final report mimeographed for final discussion with the entire staff before returning home. I never had such cooperation -- I don't think there was anything I ever put in those reports in the way of suggestion that wasn't carried out. They got busy and began writing text materials.

Bainer: I remember one period between visits that they had prepared over eleven hundred pages of text materials in different fields. Berlijn, with one of the local professors, Ledgard, who had taken his work at Texas A and M, wrote a series of seven small textbooks in the power and machinery field. They were published in Spanish by a Dutch publisher. They had a draftsman by the name of Sanchez that was absolutely an artist. And you never saw such beautiful, beautiful line drawings of everything that was in the book. There was great competition between different groups for students and in the preparation of teaching materials.

Well one of the things that just about broke my heart was that about the second trip down there I found Bacerra in the hospital with a cancer. He had been the real dynamo in getting things started. He had been replaced by a man by the name of Orlando Olcese. Olcese was president of a chain of 10 supermarkets in Lima. I think they were partially financed by Ibex which is operated by Nelson and David Rockefeller. He had travelled widely studying supermarkets, and when you went into a supermarket they owned in Lima, I'm telling you, you would have thought you were in California.

They drafted Olcese because of his business ability, to be rector of this university to fill out the unexpired term of Bacerra. The term of a rector director is five years. So he wasn't in too long. Well, when I went down there the next time I was taken up to his office, and I found that he was another dynamo. Actually, I found Olcese to be far more aggressive than Bacerra. And I'll dismiss Olcese by telling you that he knew his way around in the United States and the world, and he succeeded in -- I don't know how he did it, but he succeeded in getting enough money to build a complete new campus for that university -- nine million dollars which would not do that in the United States, but it did a lot in Peru. And, you should see the campus they developed. Initially they put up five buildings. All reinforced concrete, all three stories. They housed the library, ag engineering, agronomy, animal husbandry, and the basic sciences, with extensive one story laboratories adjacent.

The campus was built adjacent to the old campus on the north. It withstood two or three really rough earthquakes. I was in there after the first one and you couldn't find a crack in the walls but the inside tile partition walls were flat on the floor.

Bainer: Olcese made a great contribution to the university in that he went out and got the money to build a new campus. He was also very proud of the university. Ag engineering put up a few new temporary buildings at the start. They were nice looking and clean. Berlijn insisted on cleanliness. Everything was in its place and the floors were clean. Every time that Olcese had important visitors, he took them to ag engineering because it was really the show place on the old campus.

Well, we went along and in 1964 I received a letter from the dean stating that they wanted my permission to give me an honorary professorship at the Agrarian University of Peru. Needless to say, I was delighted. The letter indicated that I'd be expected to respond at the convocation. Well I felt, I haven't done very much in Spanish. I'll make up my speech and give it in Spanish. So Iver Nelson who had retired as professor of Spanish and French here on the campus helped me to write the response and coached me on pronunciation. I rehearsed it before him at least two or three times a week for several weeks. I had it letter perfect. I tell you the pronunciation was the very best Castillian Spanish that you could have. And so I arrived on the scene and on the way over to the convocation the dean said, "Now, I have Arnillas to act as your interpreter." I said, "Well, I don't really need a translator." He looked at me.[Laughter] He'd never heard me say a whole sentence in Spanish I guess. We walked up there on that stage and I have to admit I was a little nervous because here was the whole faculty before me. The award was made and I gave my response. It just poured out in much better Spanish than they were used to hearing. Afterwards, the response was "you've been keeping a secret from us!" My Dutch director who spoke five languages, all with a Dutch accent said, "Boy, what I wouldn't give for that Spanish accent. It was just absolutely beautiful!" I said, "Well, I had a lot of help." Just to pass that one off, I think of all the things I did in Peru that incident was more appreciated than anything else.

Dickman: How long did the speech take?

Bainer: Oh, I don't know. It was short, only a few pages. I could read it, but I had to hand it in. They wanted a copy for their records. Another incident that I thought was a rather touching was in connection with the first commencement in 1966. The students wrote to me ahead of time. They're very careful that they don't push you into something that you might not want to

Bainer: do. They wrote and told me that they would like to dedicate this first commencement to me. The students down there named their commencements for some professor in the university. So, I have a pennant at home that shows that this was the Roy Bainer commencement in 1966. I was really touched with that. I went down there for the commencement, and I felt I had to do something for these kids. So, I invited them all out to dinner. There was about twenty of them. I also invited the dean and some of the professors. We went out to a chicken barbeque place east of Lima, and these people just did a magnificent job feeding these kids. They brought barbecued chicken as long as they would eat it. I don't remember but I think my bill was around eighty or ninety dollars. I felt that was the best money I ever spent. When I finally left to come home, there was a dozen of those kids out at the airport at midnight to see me off. When I returned four months later, there were six of them out at the airport at seven o'clock in the morning to meet me. I mean, this was sort of touching.

We've had a couple of graduates from La Molina here at Davis for graduate work. This has given me a chance to evaluate the program at La Molina. One young fellow came here a year ago and got his master's in one year. And that's as good as anybody does.

Well this program, as I say, really developed in a magnificent way. Fortunately there were lots of fellowships for the faculty to study abroad. And some of them have been out two times that I know of. Arturo Cornejo came here about the time this program started and got a master's degree in irrigation. He went back and three years later he got another fellowship and came in here and was working towards his doctorate. He had passed all of his course work and his qualifying examinations and was called home to serve as dean. I failed to mention that deans are replaced every three years. A man can only serve as a dean for three years and then he can't succeed himself. We had Carlos Vidalon whom I mentioned was the dean when I went down there. He ended up as the Rector after Olcese. So, you see, we had continuity in this program. We had one man all the way who never lost sight of the objectives. What happened was that they just didn't have a qualified man at the time -- that was a full professor at the time that the deanship of ag engineering opened. And so what they did was to recall Cornejo. And here he was just ready to do his research. He came to my office almost in tears. He said, "Mr. Bainer, I've just got to the point where I'm really going to do this job." I said, "Yes, Arturo,

Bainer: but you just have to go home. You're so important to this project you just have to go home and serve your three years and come back." He did come back and he just got his Ph.D. last September.

We had another chap, Medardo Molina, that got a fellowship. He was interested in the fluid mechanics area. He went to Stanford, and got a master's degree in one year. He did it so easy so he got an extension on his fellowship and stayed at Stanford until he got a Ph.D. Now he's the dean. I thought, "Oh, Medardo Molina is just kind of a sleepy guy." But he went to Stanford and got a master's and Ph.D. [Laughter]

Another one by the name of Fredie Salas. He hadn't had training in engineering. He got interested in foods. And so where do you suppose he went? He went to MIT. He should have come to Davis in my estimation, but he went to MIT because of its eminence. MIT had a food technology program. He got a master of science, and went home. After two or three years he went back and got his Ph.D., came home and died last year of leukemia. This was a heartbreaker. Here was a guy that really was sharp. Now we've had faculty on fellowships at: North Carolina, MIT, Cornell, Purdue, Iowa, Iowa State, Utah State and California, at least that I know of. Plus, some places in Europe. They didn't have to come to the United States on FAO Fellowships but did on AID fellowships.

The faculty at La Molina has literally lifted itself by its boot straps through the fellowship program. They are now able to handle all engineering instruction. Three or four of the faculty on loan from the University of Engineering have stayed on a permanent basis.

This program ended in 1966. We pulled all of the experts out of the country, turned the equipment and all responsibility over to the Peruvians. About that time a fellow by the name of Enrique Blair, who was originally from Colombia, and educated at University of California in water science, saw this program. He was the head of the Andean zone of the Organization of American States (OAS). This fellow had a Ph.D. He was way ahead of the rest of them, and saw, and couldn't lose sight of the fact that here was the basis for a graduate program in ag engineering. He went back to Colombia, and is now the ambassador to Belgium from Colombia. He went right up the ladder, but during these formative years kept harping on a graduate program. So in '68 they started thinking in terms of a master's level program at La Molina,

Bainer: supported by another special fund from the United Nations. This was to be open to all students in Latin America, so it wasn't just for Peru like the first one. So in '69 they had a big kick-off for the MS program and I went back.

I found that they had five hundred students in ag engineering, but were only graduating 20 or 25 a year, but that was still a lot of ag engineers. And now they have started a master's level on top of what we had. Everybody was impressed with the new campus. I now look back on that experience because it paralleled the development of the College of Engineering at Davis. It was all done at the same time. In '61 we started programs at both places. The program in Peru was patterned after what we had at Davis. It had the same basic, common core foundation. I argued all the time that they shouldn't have food technology in ag engineering. But the point was that they had asked us for food engineering to complement food technology, but they could never get the food technology off the ground. It was going to be an institute of food technology. They saw ag engineering moving, so they just attached it to ag engineering to get it going. Now, they've separated it. But it was funny how they hooked that thing on the train because it was moving and they got this thing going. So the food technology more or less is campus wide because they've got dairy manufacturing which was part of food technology.

So here was two parallel programs, and in the period of development at La Molina they got up to five hundred students, as compared with a thousand at Davis. And I think I was just as proud or prouder of the Peruvians than I was of the Americans because they came a lot farther. One more thing -- when we were down there in August of 1969, they had a faculty of around sixty-five, and seventeen of that faculty were in the United States working on advanced degrees. They just lifted themselves by their bootstraps. They don't need anymore help from the University of Engineering, in fact they turn out engineers who are competing with the graduates of the University of Engineering for jobs in other fields of engineering. I'm trying to make a study of where all of these graduates are. I've just had a preliminary report. Most of them are in Peru, but some are in Panama, Colombia, and Brazil. They're just going to spread out and dominate the whole picture in South America.

One of the things that I didn't make clear, and that was the length of the project at La Molina. The actual contract with FAO between the Agrarian University and the FAO was for

Bainer: five full years of assistance. I visited the project periodically, and of course I went down prior to the beginning of the five-year period to set up the curriculum. The total number of trips that I made to Peru over the period was eleven.

One other comment I'd like to make, Clyde Houston of the water science and irrigation on campus was with the FAO at the time that we completed the project at La Molina. He made the comment that the home office of FAO referred to the La Molina project as a showcase and they were very proud of what the Peruvians had done in finishing up that project.

CUBA, 1962

Dickman: You've been to Cuba. Would you tell me why you went?

Bainer: Well, I suppose I'd better start at the beginning. This is an out of the blue thing as far as I was personally concerned. Remember back in 1962 or thereabouts, there was a group of about a thousand Cubans who had flown the country following the takeover by Castro. They decided to go back and challenge Castro, and take over the country. During the so-called Bay of Pigs incident their boat broke down in the Bay leaving them more or less helpless. They had thought that the U.S. was going to give them some air coverage to help them in their landing. But that fell through. Anyway they were captured. Castro, in talking with his people by radio, mentioned that he'd like to trade these prisoners for tractors--agricultural tractors. He said that he'd get far more work out of the agricultural tractors than they would out of the prisoners. This radio talk was monitored in the United States. Even though the federal government had no official connection with the invasion, there was the feeling on the part of President Kennedy that the U.S. had let these invaders down and hadn't given them the support that they should have had. So behind the scene a committee was appointed that consisted of Eleanor Roosevelt, Milton Eisenhower, Walter Reuther and Joseph Dodge who was a banker in Detroit. Reuther, of course, was the head of the auto union, and Milton Eisenhower was the president of Johns Hopkins. Incidentally Milton Eisenhower was a student at Kansas State when I was there. He was in journalism and I was in ag engineering.

Anyway, on the 31st of May, 1962, I received a telegram. That particular day I was out of town, my wife and I had been to Yosemite celebrating our 35th wedding anniversary, and as we drove in the yard on the evening of the 31st, my secretary brought a copy of this telegram. The telegram read from these four people that I mentioned, who constituted the "Tractors for Freedom Committee," which was seeking the release of the twelve hundred Cubans, is preparing a specific counter-proposal to Castro, and they urgently need the benefit of expert technical knowledge of agricultural engineering leaders. And they further stated "the Committee has the enthusiastic support of President Kennedy. The Secretary of Agriculture has listed your name as one among a small group of experts who could be of valuable assistance. There's urgency for quick action, and could you meet with our committee this Friday?" I think I got this telegram on Tuesday.

Dickman: Was your secretary a little excited?

Bainer: Yes, she was more excited than I was. Actually, I told my wife "I'm not going to have anything to do with this. In the morning I'm going to send them a telegram telling them I'm unavailable." I just didn't want to get mixed up in this. I thought there was a lot of politics involved.

Before I sent the telegram, however, I thought I'd better talk to the administration, so I called Dean Briggs and went over and talked with him, and Briggs of course was a rabid Democrat. He said, "This is too close to the president's office. I think you have to go. And if there's any doubt in your mind why don't you call Vice President Corley who was --" he was at that time our lobbyist in Sacramento. So I called Jim Corley and told him what I was up against, and Jim sided right in with Dean Briggs and said, "I think you should go." So there I was. I was undecided on my own, but here was two of my bosses at least who thought I should go.

I had told my wife when I left for the office that morning that I wasn't going. She was going to be tied up someplace for the day. After I got to the office I changed my mind, and I had a couple of appointments in the morning, and I knew my wife wasn't going to be home, so I had to arrange for someone to take me to the airport for a noon flight to Detroit. And I was in a pretty big rush. I had to get home to pack a bag. And just as I came out of the house my wife drove up and said she'd forgotten something that she was supposed to take to this luncheon. She said, "Where are you going?" I said, "Well, I guess I'm going to Detroit. I left you a note in there on the table." So I went to Detroit and I met with Reuther. Reuther was the only one on the committee that was in Detroit. Others that were invited were Professor Clarence Hansen from Michigan State, Bruce Liljedahl from Purdue, Erv Schroeder from Oklahoma State University, and William Bishop from Tennessee.

Dickman: Were these all engineers?

Bainer: All ag engineers. The problem was to sit down and work up a package of agricultural tractors, five hundred tractors with tools attached-- plows and discs and so forth. We were told that by that time that Castro was demanding something more than agricultural tractors, but they took him at his word on the first one of his broadcasts. We suggested six or eight D-6's which were as big as we wanted to go. Most of them were wheel type tractors in the 35 horsepower class, which

Bainer: would have been of great benefit to Cuba. There would have been no question about it, they would really have capitalized on that group of tractors in improving their agricultural production.

Well anyway, the committee formulated a telegram to Castro, and made this offer, and we all went home. The committee mentioned to Castro that if he wanted to discuss technicalities regarding the tractors that had been proposed, that they'd be very glad for their consultants to go to Cuba and talk to him. And so about the end of that week I got another telephone call asking me to be in Washington on Sunday for a briefing before going to Cuba. Some of the fellows had to have passports for a trip to Cuba on Monday night. Again, I just hated to go any further with this thing. I just thought it was a lost cause, really, because I knew that Castro was asking for something much larger than this little package of tractors we were talking about.

Well anyway, I went back to the administrative officers, Briggs and Corley, and Briggs felt that I was in it this far I should go the full distance, and Corley was in the same frame of mind although he said, "There's a hazard here, and I hate to see you go down there." He also said, "For goodness sakes don't give them any tractors." That was a funny reaction [laughter]--"Go down there but don't give them any tractors."

Well, my wife started having stomach pains. It always seemed whenever I got involved in something like this it really upset her. I didn't go until the midnight plane out of San Francisco. I just waited to the last minute and finally decided I'd go. I just had an awful time making up my mind.

I got into Washington, and the first thing I found out was that Schroeder from Oklahoma who had served at the preliminary committee against his own wishes--the president of his institution just said "You have to go." Well, when he got home, the people of Oklahoma were up in arms over anyone from their institution having anything to do with this, you see, and they ordered the president to pull Schroeder out of this thing. So he didn't come. They even had some parents who were going to pull their children out of the university because of his participation on this committee. The same thing happened with Bishop from Tennessee, so that only left three of us, Hanson, Liljedahl and myself.

Well anyway, we got into Washington and they decided to send a chap by the name of Pat Greathouse who was one of Reuther's

Bainer: right hand men. We also had an interpreter, Hugo Pineda, from George Washington University. And he was a gem, native Chilean. It took us all day Monday to get things fixed up. It didn't take long to get a passport. If you go to the right person in the Passport Office, you can get a passport in an hour or so. I didn't need one, myself.

Then all of the travel to Cuba had to be authorized by the Czechoslovakian Embassy in Washington. We went there and filled out paper after paper.

Well that night, Monday night, we were ready to go, and we were taken to the airport and sent to Miami; we had rooms reserved at the airport hotel. We were scheduled to go out on the five o'clock flight the next morning. The funny thing was that Castro was permitting one commercial flight a day in and out of Havana, and it had to be in and out before eight o'clock in the morning. Pan Am was flying that flight. It was kind of odd but we didn't find that out until we got into Miami. Well, when we arrived in Miami, the sheriff came on the plane with two deputies, and asked the stewardess where the commission was. We were sitting across from each other in the same row, and we were the commission. [Laughter] I didn't know we were the commission, but we were. So the sheriff came up and told us that there was a man in the airport that was going to attempt to make a citizen's arrest. That we were in violation of the Logan Act which states very specifically that no individual citizen can deal with a foreign power. I knew something about this act, and before we left from Washington we got clearance from Bobby Kennedy's office that we weren't going to be subject to this act. We were going to be free of any involvement here. The sheriff said, "We're going to take you off the plane first. We're going to take you down through the subway and over to the elevator and up in the hotel without going through the lobby."

We were on the top floor of the hotel and they had guards there all night. I began to wonder what we were going to run into in Cuba if we were having this problem in the United States. About four o'clock the next morning we were awakened. When we went down to check in at the Pan Am desk, there was a fellow by the name of Voorhies, who attempted to make a citizen's arrest. There were police there and the police kept him at a distance so that he never got his hands on anyone, so we boarded the plane without further incidence.

We had made reservations at hotel Vedado in Havana, which was downtown, just an ordinary hotel. We didn't want to put on

Bainer: any dog or anything. So finally we arrived in Havana, and were met at the airport by Presidential Aide Capt. Fernando Otero, Major Luis Crespo and Rafael Hernandez. Crespo had been a pitcher, I think, for the Cleveland Indians or some team in the National League at one time. We were told immediately that they had cancelled our rooms at the hotel downtown, that we were going to stay at the Riviera which was a beach hotel now owned by the Cuban government, and that we would be the guests of the Cuban government all the while we were there. It was a very nice little reception that we had. We were taken to the hotel and checked in. There were very few people at the hotel. We were put up on the 18th floor, with two of us in a room--double beds. There was a vacant room between the two rooms that were occupied. The interpreter had a room by himself, across the hall from us.

After checking in, we were ready to do whatever they had planned. They had two cars to haul us around, one was a Lincoln, the other a Cadillac. We asked them where we were going. They said, "Well, you're going to visit the prisoners." They had a delegation of ten of the prisoners who had been to the United States in contact with the committee--trying to resolve this whole thing ahead of time. So here we were with the 10 prisoners. A fellow by the name of Ceferino Alvarez was the spokesman for the group.

The thing that you observed right off the bat was that these prisoners were in a good frame of mind. They were well-dressed--I mean as far as prisons go--clean uniforms and they were smoking cigars and [laughter] and they seemed to be having a lark out of this thing. The first thing that Alvarez did was to thank us for coming. He questioned our power to act-- we had no authority. And, he gave us advance warning that the list of the tractors and the equipment that was submitted on June 2, did not cost enough to pay for the damage of the invasion of Cuba. In other words, they were blaming the United States for the invasion. Remember that there was no one from the United States in the invading party--they were all Cubans. They estimated that the amount of damage that was done to the Cuban government was in the neighborhood of twenty to twenty-five million dollars, and so in order to get this equal amount in tractors, Castro had requested five hundred D-8's which was the biggest crawler that Caterpillar Tractor built, plus bulldozer blades, on three hundred of them, heavy duty disc harrows on the other two hundred and repairs for five years. And there were other things that came up that I'll mention later that he wanted. They said that Castro would take X number of D-8's

Bainer: and the balance in other tractors and equipment, as long as it came to twenty million dollars, and if they didn't want to give it to Castro he'd take a credit for twenty million dollars. Alvarez said they'd be brief, that no negotiations were possible unless they were based on indemnity. In other words, we were paying for damage. And he said that if the negotiations were successful, that all the prisoners wanted to leave at one time. They were afraid that if their exit was strung out that some of them might not get out. They wanted air transportation for the sick and wounded. As you remember, probably, there were three priests involved in this invasion. Cuba had already deported them to Spain so they weren't involved. They believed that the count of prisoners was 1197, and they thought that Castro was in a receptive mood and would accept the tractors requested and it would be very simple. All we had to do was to meet Castro's demand. I mentioned that they looked well, and were dressed in clean clothes. Water was brought in twice and coffee was brought in for everyone, and it was a rather pleasant session. It lasted about an hour and a half. Then we bid them goodbye.

The next call was on the president of Cuba, Osvaldo Dorticos. I don't know whether the accent is on that second to last vowel. This contact with Dorticos ran about two and a half hours. Crespo and Cabre were there. They had their own interpreter and we had ours. And the first thing that Dorticos told us was that Castro was out of town and he didn't know when we'd be able to see him. And he indicated that we probably should load up in a plane and go out and look for Castro. [Laughter] It was kind of ridiculous, and we told him that Mr. Castro had invited us there, and we were guests of the Cuban government, we understood, and if Mr. Castro didn't want to see us we'd go back home in the morning. There was no reason for hunting him up. Apparently what Castro wanted us to do was to meet him at the site of the Bay of Pigs. It was very evident that he wanted to play this thing up. We told Mr. Dorticos that we were private citizens with no official connection with the United States as far as this deal was concerned, that we were on a humanitarian mission, we wanted to free these prisoners and also improve the agricultural production of Cuba, thereby raising the living standards of the people of Cuba.

Well, of course, Dorticos started right in where these prisoners started in, and he said that the Cuban government had a claim of indemnity against the United States for the invasion and he said the tractors would pay this debt. And

Bainer: he also told us that 18 of the prisoners had criminal records and would not be released under any circumstance, and their names were read off. In the case of the priests, we don't have to consider them. They were Spanish subjects and they have been deported. And he went on to tell us that by afternoon he would be able to furnish us with the complete list of all the prisoners. We asked him for that. We already had a list from the State Department. He started out with the request from Castro of 300 super D-8 tractors with bulldozer blades, 200 D-8 tractors with the heavy disc harrows. The latter weighed almost nine tons. And they wanted them all equipped with winches and they wanted spare parts for five years or ten thousand hours, and he kept re-stressing the indemnity feature of this exchange. And he brought up this matter of the twenty-four million dollars in damage that was done, and so on and on.

He accused us that we lacked power to act, and he said that in other words we were just trimmings, you know, and that anything that we had suggested, the people of Cuba knew better than we what they needed. He belittled us all the way through. They said they had experts in Cuba, and that they already had some similar equipment, they knew what they wanted in the way of equipment for land clearing, building roads, dams, and reservoirs. Well, we didn't get very far. And then he finally said we might be able to see Castro after lunch. And as I say, he wanted us to fly out and meet him some place on the island.

Following this we had lunch. It was interesting, a young fellow Rafael Hernandez who was with us an interpreter from Cuba (I'm sure the Cuban government didn't want him to intermingle with us) was invited to come in and be our guest for lunch, and boy, he accepted right now. We got a lot of background material from this guy. I don't know if he was a dyed in the wool revolutionist or not. After lunch then, this was of course dragging along late afternoon, we were told that we were to meet with the mechanization committee on land reform. This committee was made up of four or five of righthand men of Castro's, and it started in about where the president left off. There was a lot of repetition of what they had to say. They claimed that they already had 65 D-8 tractors with blades and harrows, but they couldn't furnish any data as to how much land they'd cleared. They knew that the large D-8 gave excellent results, and that they, in 1962, expected to clear about a third of a million hectares using two hundred fifty of these tractors. They also gave us their goal for the next seven or eight years.

Bainer: And of course it was the same type of equipment I've already mentioned. They showed us a lot of pictures of their tractors and showed us some smaller tractors that were bogged down in the brush and indicated they had to have the big ones in order to get the job done. So, this went on to approximately six-thirty that night. They also gave us a list of other equipment they had. I was surprised that they had 169 combines for rice.

At the end of the session we were told that we would get to see Mr. Castro in the morning at eleven thirty. So, we went back to the hotel and had dinner. We thought we'd better get things pretty well organized as to what we were going to talk to Castro about. So we decided to meet in one room. We went into Hansen's room, and we were just positive that these rooms were bugged. We looked all over, of course, behind the curtains, under the bed, under the rug, and all over the room for microphones, and failed to find any. However, on the wall board on the side that the vacant room was on, was an outlet about a half inch in diameter--a hole--it was an outlet for some wiring that could come into the room. We figured that there was a possibility that there might be a microphone behind that little hole. So we took a pillow off the bed and propped it up against the hole and went clear over on the other side of the room and talked rather in low terms. We really didn't have anything secret to talk about, but we wanted to get organized and didn't want them to know what we were talking about. Well, in about ten minutes there was a loud knock on the door. We sent our interpreter to the door, and there was a bushy-faced guy in fatigues with a .45 in his hand. I'm telling you, I just thought this was it. I thought some crackpot had gotten on this floor and he had a gun with six shells--one for each one of us. I was just petrified. I just was. I don't know when I've ever been so scared.

He asked our interpreter if Mr. Hansen was in this room. He said, "Yes," and the guy said "that's all I wanted to know" and walked on down the hall. Well what had happened was that they had lost contact with us. And while we weren't told we were under house arrest or anything, it was very evident that we were pretty much under surveillance. After the shock, I'll tell you [laughter], we got organized and we went to bed. I remember I was in the same room with Bruce Liljedahl and he was so upset. I tell you this guy was just so upset he never slept a wink all night. He told me that he took four hot baths to get in a mood to go to sleep, and he said, "I got so mad at you. You lay down on that bed and just went right off to sleep. You snored [laughter], and I don't

Bainer: see how you could be so calm." The next morning I said, "You know, we're too valuable to these people for anything to happen to us." The interpreter also was scared to death.

Dickman: Had you brought this interpreter from the states?

Bainer: Oh yes, we brought him from George Washington University. But he was a native Chilean, and he was afraid that they might want to keep him or something, I don't know. Well anyway, we went down and met with Mr. Castro the following morning. This session with Castro lasted three hours and forty minutes. We didn't accomplish a lot but we talked a lot. It was very nice. Castro has a degree in law from Havana University. He's a very smart man. Don't sell him short where brains are concerned. He spoke English but he wasn't going to trust us in this conversation he had with us. He had his interpreter and we had ours. We had one interpreter checking the other. And it gave us more time. Now, I could understand some Spanish too, but it gave me time to get some very copious notes, and I felt we might need them.

In the session in Washington on Sunday afternoon Reuther's brother came in and wanted to kind of prepare us for what we were going to run into with Castro. He said, "He'll pound the table and he'll rant and rave and he'll do this and that." Well, the guy couldn't have been any further wrong in what he expected Castro to do. Actually Castro did have respect for university people, and here we were from universities. And we were given every courtesy as far as our relations were concerned. So we opened up, of course, with the statement we'd already given Dorticos, and Castro felt that the main committee (now we were just advisors--consultants to the main committee) was powerful enough to influence the government of the United States regarding political prisoners and the like. And he thought the committee was sympathetic. Certainly he should have thought they were sympathetic in trying to straighten things out down there.

I might tell about him. He sat down at the end of the table and he never once failed to have a cigar in his mouth. He had an ashtray in front of him but he didn't use it. The ashes went on the floor, and when the cigar was smoked down half way or so, it didn't go in the ashtray, it went on the floor. And there was a man standing behind him with a rifle the whole time we were talking with him. He didn't trust us. Every time Castro needed a cigar the guard reached into his

Bainer: pocket and got another cigar and lit it for him. Castro never took his hat off. He had a sort of a tam sort of a thing. When you got through his whiskers he looked quite young. I mean to me he didn't look as old as his whiskers might make him look. Different ones came in at different times. Castro had a pistol on him, and two people sitting on each side of the table next to Castro had guns and they laid them on the table. So, we were well protected. They weren't taking any chances, even with us.

Well, we talked and we talked. We had a hard time keeping Castro on the subject. He wanted to talk about everything. He wanted to talk about what the university kids were going to do the next summer. They were going out and teach the illiterate Cubans how to read and write, and he had a volunteer army of--well, he was mobilizing a hundred thousand students to extend education to the rural areas, and these were not only university students but high school students as well.

Among other activities to keep people occupied, Castro had drafted young people (boys and girls) to serve in a home guard type army. They were in uniform and were quite evident throughout Havana. They all had rifles. I asked "where are the barracks - where do you keep these people at night?" I was told that at the end of the day everyone checked his rifle in and went home. Sand bag barricades were in evidence all around the city.

I think the funniest thing I saw was a girl, that I judged to be about 15 years of age, on guard at the entrance to the hotel. She had a stick of candy in her mouth. When we approached the entrance, she stepped aside dragging her rifle across the concrete walk.

We asked him what he was going to do with these tractors. He said he was going to build a hundred new towns, and he needed them for road construction, land-leveling, transportation, mining, dams, reservoirs, canals, and nothing about agriculture. We told him that these tractors were not agricultural tractors, and he knew that. But I made some remark about air strips and he laughingly said they might build airports, too. Of course we felt that probably what they needed these tractors for was trading stock. After all there's no tractor the size of a D-8 built anywhere in the world except the United States. They're in heavy demand, and certainly behind the Iron Curtain they'd like to have some D-8's and we figured if he had 500, he'd have twenty-five

Bainer: million dollars worth of tractors he could do some trading with it.

Well, we presented the package to him, and we talked more about insignificant things like how many pigs they had, and what he was going to do to improve the poultry flock, and so forth. He just didn't seem to be able to keep on the subject matter. Finally Castro made his demand which I already mentioned--300 D-8's with blades, 200 with harrows and the spare parts for five years. The combined market value now was twenty-eight million dollars plus transportation. We told him this was out. There wasn't any use talking about 500 D-8 tractors. It just wasn't in the picture. We had been told this by the committee. Well then he said, he'd take 200 D-7's with blades and the rest of the twenty-eight million dolars that he had mentioned in D-6's with 6,000 pound harrows, this is 3-ton harrows. And we told him this was out of the question. Then he made a next proposal which was he'd accept twenty-eight million dollars worth of D-6's with harrows and spare parts. To show that he knew a little bit about the power of these tractors he wanted to remind us that he was accepting 80 horse power tractors instead of the 185 he'd asked for.

Well, we mentioned four wheel drive tractors. Finally Cabre came into the picture and he said that they would accept some Allis-Chalmers 11's, and Caterpillar D-6's and International Harvester PB 15's. I think he was wrong on that number, but--well, it ran along for a while and Castro said, "We've got to produce rice, corn, cotton, millet and pigs." He always got off on some tangent and he wasn't going to use these tractors for this, you see. And he was talking about the fruit tree nurseries and the planting of timber trees. He was just trying to brainwash us. You see, when we didn't warm up to a proposal he made another one, and another one, and finally he said "In the next proposal I'll just take a credit card for twenty-eight million dollars and I'll buy what we want, and there wouldn't be any D-7's or D-8's requested." But he wasn't going to compromise on the total value. He wanted twenty-eight million dollars. He said that he must convey to the nation that he'd been compensated for the invasion. He had his face to save, too, you see. Then when we didn't go for it, he said, "I'll tell you what I'll do. I will release these prisoners on the condition that the committee in the United States can influence their government to convince other nations of the world to release our political prisoners they're now holding." In other words,

Bainer: there are political prisoners scattered throughout the world. "And this won't cost you a dime. We'll give you these prisoners." Well, the point was that after three hours and forty-five minutes of this we just weren't getting anywhere.

Toward the end of our first meeting with Castro, he gave us a typed list of all the prisoners. They numbered as follows: 1173 to be released, 21 criminals and leaders to be held and 3 priests that had been deported to Spain.

We had to hold our line. After all we were told how far we could go. He said finally, "Well, you people don't have any authority to modify or to meet the terms, and I suggest that you go back to the hotel and get in touch with the committee in the United States and find out how much farther you can go." Well, the thing was, when we went back to the hotel, we knew that it was a lost cause. I said, "When will we see you again?" He said, "I'll let you know, but it'll be some time this evening."

We went back to the hotel and had about three or four hours before dinner. I sat down and organized the material covering all of our meetings with the Cubans so that when we got back to Washington we could discuss it with the main committee. Also this extra time gave us a chance to recoup and prepare a final statement. When it came time for dinner I told the fellows, "if we're going to get anything to eat, we better get started because the dining room closes at eight o'clock." You see there were only a few in the hotel--some Chinese and a few Russians besides us. Here was an 18-story hotel with about 25 people in it. And so we decided that we'd go down and have dinner. About half way through the meal we heard a commotion in the lobby and here came Castro and his followers. Apparently the word had gotten out that he was going to be there, so there were a lot of citizens there. The lobby was full, and one of the things I failed to mention was that when we were asked to come down, Castro also invited the press. This was the first time the press had been in there. I mean newspaper people hadn't had much access to Cuba, you know, and they were having a heyday, and they were following Castro around and interviewing him and interviewing others.

Dickman: The American press?

Bainer: Yes, the American press--and some Canadian and even European. There was one from London and one from Canada, I know, and from the Christian Science Monitor and Time Magazine. So here comes Castro in with his bodyguards and the press following him. He came right over to the table where we were having dinner and we got up and I said, "Well, where

Bainer: do you want to meet?" And he said, "Oh, sit down and finish your dinner. You're only half through." [Laughter.] This guy sat down right beside me with the cigar in his mouth and his hat on--never took his hat off--and wanted to start talking business. And the press pulled up chairs, to form a circle around us. They were going to hear everything that was being said. They'd been trying to corner us and get a statement, and I wouldn't give a statement. We just wouldn't give a statement and I said, "You'll have to get all of your statements from the committee." Castro was very talkative, and I thought, well, we'll have to get him started on something else while we finish up our dinner (and I didn't enjoy very much more of my dinner, I can tell you that). And so we asked him "How much better off are the people in Cuba since the big revolution?" So he called a waiter to come over. And boy, this waiter, I'm sure he just wanted to drop through the floor with Castro calling him over there. He said, "What was your rent before the revolution?" and the waiter told him. He said, "What is it now?" and the waiter told him. And, it was about a third! In other words, one of the first things he did was to chop all rents in two for all the people. So, they were all enjoying it a lot. [Laughter.] We kept him busy, you know, just answering rather foolish questions. I should have had my list of some of the questions we asked him. But he liked to talk, and he talked and he talked. Finally we finished and I said "Okay, let's go and have this final meeting." He said, "Well, could you wait just a minute? The press here has a bunch of photographers and they want pictures." So I had to pose with him--we were all posing with Castro. The flash bulbs were popping and they got their pictures.

Afterward I said, "Well, let's go and get this business over with." So we walked through the lobby, I assumed that Castro had a room some place where we could go. And women would come up and get down on their knees and kiss his hand. It was the darndest experience. The people, you know, worshipped the guy. We walked right by the registration desk and entered the elevator. He saw that he had the right bodyguards with him. I still didn't know where we were going. The guy looked at me and I said 18 (gave it in Spanish), and went up to the 18th floor and walked down to Hanson's room and had the last meeting with Castro there. There weren't enough chairs to go around so some people sat on the floor. [Laughter.] Oh, it was ridiculous. So the final statement that we gave Mr. Castro "that we were authorized, as private citizens, by the committee to make a decision on the type and size of tractors together with equipment offered to

Bainer: secure the freedom of twelve hundred prisoners and to help the Cuban people. That we were prepared to provide 500 agricultural tractors and implements in an acceptable variation of the types outlined in the June 2 proposal. If this is acceptable we will proceed immediately and begin shipment within the next two weeks. As to your proposal, it is our decision to have further discussion and consultation with the other people in the United States prior to giving you an answer." In other words, we just didn't say "No," but I knew that's what the committee would do. Mr. Castro wouldn't accept our proposal so that was the end of the interview.

We had reservations on the early flight the next morning. You see the flights had to be in and out of Cuba by eight o'clock in the morning. The Cuban people were still looking out for us--met us at the hotel, took us to the airport, and we checked in.

Dickman: No bill?

Bainer: No bill. I tried to buy Cuban newspapers, because they were covering this thing in a big way, but I couldn't even pay for a newspaper. We got to the airport and checked in, loaded up on the plane, and they started the engines and everything looked like we were going to go. Then one of them konked out. We sat there with three engines running while they tried to get the fourth one started. And finally all four of them stopped. It was eight o'clock, and it was announced that the airport was closed and here we sat in this darn plane. We didn't know when we were going to get off. So we left the airplane and went back to the terminal. But they wouldn't let us go inside because we had all checked out. They were afraid that some unauthorized people might get on the plane. We sat there in the heat for four hours and finally about noon we were told that Castro had okayed the departure of this plane. Well that put us in Miami too late to catch our scheduled flight to Washington. We were all set to get back and have a meeting of the committee that day.

Well, we finally got into Miami, and when we came off of that plane, there was a mob of Cubans. They were clapping and cheering when we came off that plane in appreciation of the fact that we had gone over there and tried to free those prisoners.

Bainer: They took us direct from the plane up to one of those VIP rooms in the terminal and they gave us a credit card and told us to call our wives. I called my wife, and told her that I was in Miami. She said the minute she heard my voice her stomachache left her. She said, she'd had it all the time I was down there. She said, "I was just a nervous wreck." The funny part is that we were sitting there after being scheduled to go out on a later flight to Washington. We were told where we were going to stay in Washington, that there had been an arrangement made for a meeting with the committee at nine o'clock that night. As we sat there waiting somebody, I don't know who was running this show, said that the TV cameras were all set up downstairs, and we just had to go down and make an appearance before the cameras. They said, "You can walk through and they'll have it documented that this is the commission that went to Cuba to talk to Castro. They just have to have this." This was also ridiculous, but to please everybody we said, "All right. We'll walk down and come in and appear to be getting off the plane, you know." We didn't have to make any statements, understand. Well, we were walking along in an area that was roped off. There were hundreds of people in this airport. It was just amazing how many people turned out for this--but I didn't give it a second thought. We were in front of those cameras when Mr. Voorhies came under the rope and grabbed two of us. And of course the guy with the microphone wanted to be sure he picked up anything that was said. The first thing I knew, I said "Get your cotton picking hands off of me" there was a microphone right in front of my face. [Laughter.]

The funny thing was there was a prior announcement that we were going to be on TV. Someone called my wife and said, "Be sure and turn on your set because Roy's going to be on TV." She got it on just as this guy grabbed me. I'd already talked to her, she knew I was in the United States, but she didn't know what to expect then. And the guy said, "I'm making a citizen's arrest. You fellows have violated the Logan Act." There were policemen there, and he said, "Officers, take them." And you know, the officers wouldn't touch us. And he said, "Somebody get the district attorney. I've got these people." Well, the point was we finally wrestled clear of him and went back upstairs. The last I saw of him he was running through the crowd with a bunch of Cubans after him [laughter], and I don't know what happened to him.

Dickman: Was this Voorhies related to anybody here named Voorhies?

Bainer: No, he wasn't. But I want to tell you about something that happened later after I came home. We went into Washington but our bags didn't make it. I didn't have a clean shirt. Well, I went out hurriedly and picked up one, before the meeting. A meeting was scheduled with the committee in the Mayflower hotel at nine o'clock. We were ushered up to Mrs. Roosevelt's parlor, she had a suite with a parlor. Milton Eisenhower never did come. Dodge and Reuther were also there. And I'll never forget--Mrs. Roosevelt had a maid, but she came out of her bedroom with her petticoat showing about three inches in the back. And I thought, "My goodness, how could a maid ever let a woman of her stature come out with her petticoat showing."

Well, we told the story from beginning to end. It took about two hours; we told it in more detail than I've told it here. At the end Mrs. Roosevelt said, "This is preposterous!" I'll never forget the way she said preposterous. [Laughter.] The next morning her committee (I mean she was kind of a spokesman for this group even though she was just an honorary chairman) sent Castro another telegram in the morning reoffering just exactly what we had offered and told him either to take it or leave it, and he didn't take it. And, that was the end of that episode. Well as you know, they finally settled this later. He accepted two million dollars worth of drugs for these prisoners, so we finally got the prisoners released, but it was an exchange of drugs for prisoners.

Dickman: For two million dollars.

Bainer: For two million dollars, and I think it gave all of the drug houses in the country a chance to clean up their shelves. [Laughter.]

Well anyway, the next morning, I was having breakfast at the Executive House in Washington, I hadn't picked up a morning paper--I don't know why I hadn't. I was sitting there, and a guy at the next table was reading one. I looked over there and I could see "Mr. Bainer and Mr. Castro" on the front page of the Washington Post. So, I walked out and got me a paper, and I thought, "Well, while out there I'll get the New York Times also." So here I was shown in two different poses with Castro. The other guys had been left out of the picture. I went home by the way of Los Angeles into San Francisco. So I picked up the Los Angeles Times and here was our picture

Bainer: on the front page. I made more front pages on that day--June 9, 1962. And for the next two or three weeks, I got pictures that people cut out of papers, such as the Stars and Stripes, the Paris edition of the New York Times, etc. They got a kick out of sending that darned picture of me. So this was a kind of an interesting episode that I'll never forget and I hope I'll never duplicate again. But it was a lost cause from the very beginning. I just knew we were never going to get to first base because Castro had changed his mind. He thought that he was in the driver's seat. And here was a powerful committee, and that they would eventually be able to influence the whole group.

The committee had asked that donations be sent to Dodge in Detroit. They were--I don't know how many thousands of letters--they were never opened. When the deal fell through, the letters were returned to the senders. There were quite a few letters that didn't have return addresses so they had to be opened up and I don't know what they did with the money. There were a lot of other activities that raised money. Mrs. Roosevelt had been sent--she told us as much as $25,000 from different groups and she had to return it all. Whether they ever raised all the money that was necessary to buy all these tractors is still a question.

Dickman: So you never did meet Milton Eisenhower?

Bainer: Never met him. He never appeared at any committee meeting. We had all the others but not Milton. I think he was a Republican who happened to be on this committee for his good name whether he ever met with them or not or whether he just lent his name--he never showed.

Dickman: There was an Oakland Tribune story July 18, 1963, that said that he was bitter that President Kennedy had failed to explain the matter to the American people. Did you get any of this while you were there?

Bainer: No, the thing that we were told was that there was no connection between the committee and the government. We were emphatically told that this was a committee of free citizens that were going to do this job. We knew from what we could pick up from here and there that the committee had been appointed by the president--or that the president had contacted and asked them to do it. It was evident that they didn't want to connect the committee with the government. Yet there was a feeling that Kennedy had let the invaders down. Because apparently when they talked about the invasion,

Bainer: the invaders thought that they were going to have an air cover when they went in. But the thing that really stymied the whole thing, you know, was that their boat broke down--their engines konked out on their boat and they were stuck out on the Bay.

Well the aftermath of this Cuban episode, of course, was the invitations to all the service clubs around--mainly Rotary Clubs. I had talked to these clubs back in 1945 when I went to England and '48 when I went to Japan. It just seemed like I got on a circuit and when I went to Cuba the same clubs thought they ought to have me back, I suppose. And then the other groups--student groups, I just talked about this at the Hammarskjold House last fall.

Dickman: I remember, a few weeks ago.

Bainer: Yes, a few weeks ago, and this is the second time I gave it at the Hammarskjold House. Of course it was a new bunch of students. I remember giving it at the apple polisher's dinner at the SAE house. They had several faculty men there. One was a professor in history. He wrote me a letter the next day and asked me to get this thing typed up and put it in the library for posterity. He said, "It really ought to be published some place." I never felt that I was in a position to do this. After all, we weren't part of the committee, we were just technical advisors to this committee on Tractors for Freedom. I didn't want to step in now and appear to be an important part of this thing. I wanted to keep that supressed, so I wasn't very anxious to stick my neck out on a deal like this. I had one or two letters from cranks that were very disgusted that anybody from the university would get involved in something like this, but they didn't sign their name, they were cowards. I had one telephone call from a rancher's wife that thought I was smarter than to get involved in something like this, etc.

Dickman: Any reaction from any of the regents?

Bainer: No, not a one, and no reactions from anyone in the university. But as I say I got two crank letters and one crank telephone call. And I got a letter from a fellow in Connecticut. His name was Bainer and he was in the insurance business. It started a little correspondence between us trying to find out if we were from the same family tree.

Bainer: One more facet to this story should be mentioned. At the first meeting of the local Rotary Club after I returned home, they had some fun with me. They had invited Ed Voohies to the meeting. He grabbed me and said that he was making a citizen's arrest for violating the Logan Act. They had the Chief of the Davis Police there. He stepped up and put handcuffs on me. Of course, I was glad that it was all in fun.

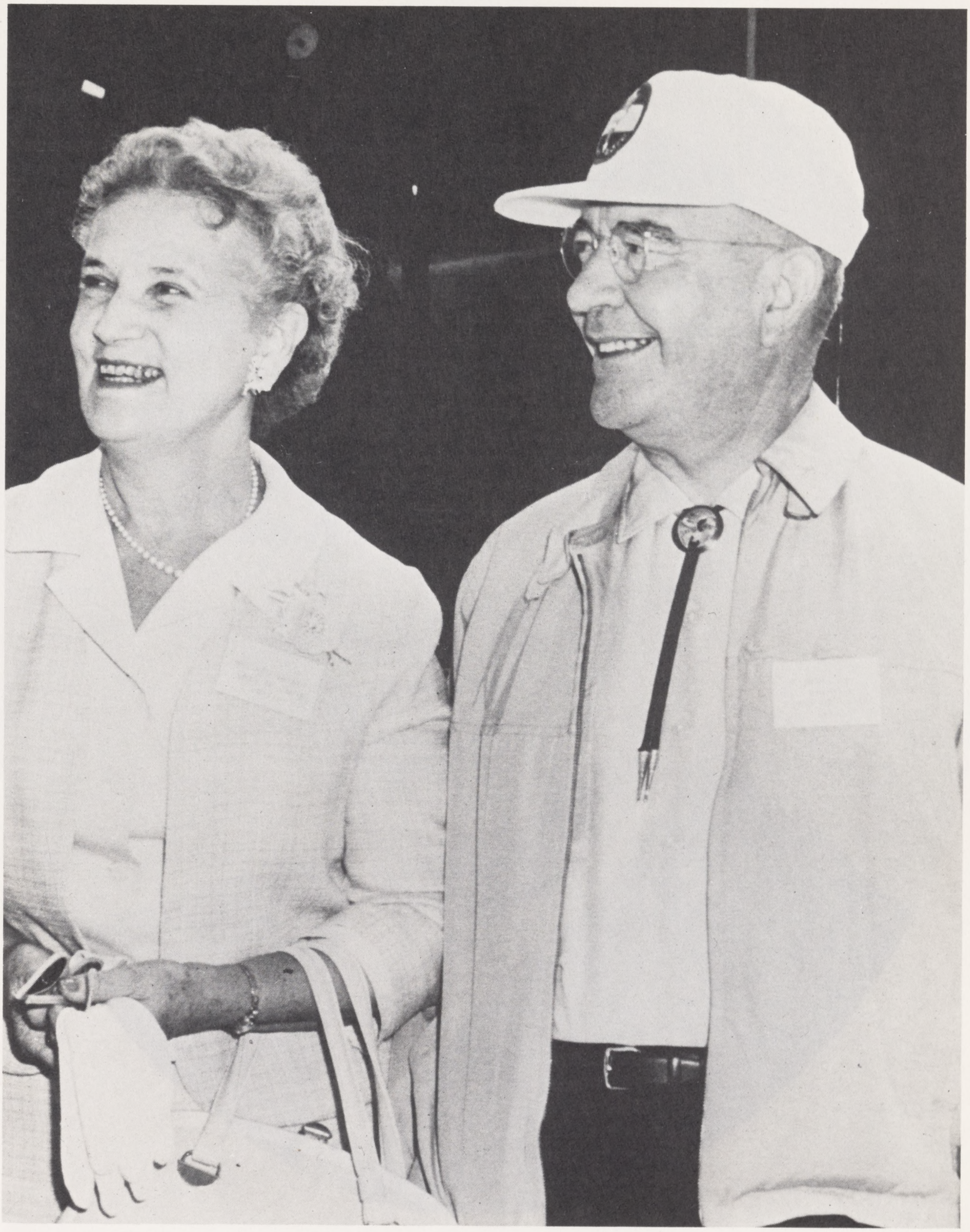
LAOS, 1966

Dickman: What was your next consulting assignment?

Bainer: Well the next consulting assignment was in 1966. I was called by the State Department in Washington and asked if I could spend a month or so in Laos on a follow-up after Vice President Humphrey made a visit there. Some suggestions had been made by Vice President Humphrey to prime minister Prince Souvanna Phouma regarding equipment for increasing rice production. This request came at a very, very busy time for me. I told them that I couldn't go. They went right over my head to the Chancellor's Office and the following Monday morning I got a telephone call from Chancellor Mrak asking why I couldn't go. And he said, "We think that this is important enough that if you can possibly go you should." So, I found myself going to Laos. In other words some of these trips were really made against my better judgment. Afterall you can only do so much, for one reason or another you try to avoid going.

The State Department had arranged with Lloyd Johnson of the International Rice Research Institute at Manila, which is run by the Rockefeller and Ford Foundation, Joe Drilon, the economics officer of the rice station, and Vice President Nathanial Tablante of the University of the Philippines to be the other three members of my team. I was to be the leader. I was to stop in the Philippines for an organization meeting with these three people. Then go to Thailand. Drilon and Tablante had been to Laos before. So this was going to help quite a bit because they were somewhat familiar with the country.

Well after a couple of days at the Rice Research Institute we moved on to Bangkok where we made a brief study of mechanization in Thailand, --- to what extent they were using tractors for land preparation and what these tractors were. This gave us quite a little background as to what was going on in a neighboring country to Laos. You see there was nothing separating Laos from Thailand but the Mekong River. Finally we were ready to go to Laos. We took the Royal Lao airline. It operated an old DC-3. It was the only DC-3 that I was ever served a meal on. When we landed in Vietnam, I said to the fellows, "You know we're halfway home." [Laughter.] I had all sorts of misgivings because Laos is pretty much at the bottom of the totem pole I tell you as far as development of the country.



Mr. and Mrs. Roy Bainer — 1965

La Nelle Bainer — daughter.

Bainer: I didn't know what to expect. I took all kinds of guards against mosquitoes and everything else. It was a hot sticky evening when we arrived and they took us to the Lane Xang Hotel. It was right on the Mekong River. It was a beautiful hotel, about four stories and built by the government to encourage tourist travel apparently. Of course it was not being run by the government at the time. The lobby was open. There were no windows or doors. The mosquitoes just about ate you up when you were registering. I was so glad that I had mosquito netting and all kinds of repellents with me. We were taken up to our rooms and when we opened the door and stepped in the rooms were air conditioned. They had been in there and sprayed and knocked the mosquitoes down. All the time I stayed there, I never had a mosquito in my room that I knew of.

Joe Drilon had been there before. He was a little Filipino fellow. He was really a sharp guy. He more or less took over in the handling of all of the details of our trip. And since he had been there before I said, "What time are we having dinner tonight, Joe?" He gave us the time. Well, we went down to the dining room, and here was a French maitre d'. You see the French had been in there in years past. The menu was in French and I didn't know any French. I said to the maitre d',"Just bring me a nice dinner." [Laughter] That's all I said. And he went all out, and I had a very, very wonderful meal. I said, "Who cooked this meal?" He said, "Several years ago the Laos government persuaded a cook on a French liner to take over the chef duties in this hotel and he stayed." And they had the French cook and this French maitre d'. I made no attempt to order. I just told him, "Bring me a nice dinner." And I liked it too. And they served wonderful pineapple and bananas, things like that just had a different taste from what we get here.

Well we went up the following morning to the headquarters and got briefed on what we were going to do and met with Prime Minister Souvanna Phouma. He's still prime minister. Laos had a civil war going on. They were fighting among themselves and the leaders of the two sides were step brothers,---Lao against Pathet Lao. Phouma led the Lao and his half brother Prince Souvahanouvong led the rival Pathet Lao. About 10 percent of the male population were fighting in the Lao army. They were short of manpower to prepare land for rice production. They really needed some power for plowing. Humphrey had stopped in Laos and visited with the prime minister. The prime minister had told him that he needed tractors to plow for rice. He said, "Without this help, our people are going

Bainer: to get hungry." We (the U.S.) of course, were interested because we were air dropping rice into that country. They were short some sixty thousand metric tons of rice per year. We were furnishing a lot of this and Humphrey was quite hopeful that we could help them. He made the remark that we had lots of tractors and he kind of built this thing up. The State Department thought someone should go in there to see if the tractors could be used effectively.

We went from the prime minister's office over to the agricultural department, which was run by Prince Tiao Somsavath who wasn't trained in agriculture. In fact when they set up the present government they made no provisions for secretary of agriculture. And the young fellow, that was from the royal family that was acting in agriculture, had a degree from some university in France. He was interested in setting up an agriculture college which surprised me a little bit and we were sitting around talking and he wanted to know about the land grant college system. And I don't know how he came to get off on practical education, but of course that's what they needed. He had visited San Luis Obispo at one time when he was in the United States. He said, "What we need in Laos is another San Luis Obispo," and he came down on the table with his fists. And that just floored me, but it was true, you see! This is the sort of thing they needed. But, he thought it could be done on a lot less money than it would take.

It was decided that we'd make a little aerial survey over the Mekong Valley, trying to get some picture of how extensive it was. How much level land. See, Laos is a mountainous country. I never saw so many mountains in my life. Only about seven percent of the total area was classified as farm land. We flew over various areas, mostly around the Mekong River. We flew up to Luang Prabang where the king's residence is, and then by jeep to several locations. We flew to Savannokhet, Sayaboury, Paksane and Thakhek where there were jeeps to take us out over surrounding country. I remember flying along the Mekong and the pilot went up about ten thousand feet, and he said, "You know, there's some activity down there underneath us, and when there's activity I get over the top of it." The Ho Chi Minh trail was very active you know on the side of Laos, and the North Vietnamese were infiltrating the country. There wasn't any question about their activity. The only people that were immune to the enemy were the road builders. The State Department was helping build some highways in Laos, and anything painted yellow, tractors, road graders, automobiles, etc., were left alone because the enemy knew they'd need

Bainer: that road just as badly as the ones we were building for. So the best way to be immune from enemy attack was to have equipment painted yellow.

We were often taken along a road and a fellow would say "You know, this time last year we couldn't have made this trip down this road," and I began to worry -- there was a lot of brush along that road. [Laughter] Well anyway, we made quite a little survey of the farming area. What was happening was that the people along the Ho Chi Minh trail were being transported into other areas and re-established on farms. Each family was given about five acres of land by the government. The government (Royal Family) owned a tremendous amount of land. They couldn't homestead land there but they could get permission to farm it. And as long as they farmed it, it was theirs. The minute they gave it up, someone else can come in and farm it. They were clearing more land and planting rice on hill sides. When the fertility level dropped to where they couldn't produce the rice, they'd clear some more land. They had beautiful timber that was being cut and burned.

After we'd made the aerial survey and some of the ground trips into the interior valleys we went back to the Vientiane plain by car for a more detailed study. The first thing you know we came across a couple of tractors in the field. Oh, I should go back. When we were talking to the prime minister it was too late in the season to get any new tractors into Laos. We suggested to him that some tractors be rented from Thailand on the other side of the river. This would give some idea of how they could be used in the preparation of the land for rice. He accepted the idea. He didn't even know they had any tractors in Laos.

Well the point was that when we started making this detailed study of the Vientiane plain, we found several tractors. One of them was owned by 30 farmers. They'd each put in a hundred dollars. They didn't have much money so they bought this tractor between them and they were farming as a cooperative. They were getting along so well in the preparation of the land for rice that they leased another tractor. With the aid of two tractors they had plowed about five hundred acres. This was a tremendous thing in Laos. We went up the road a ways further and here was a fellow with two diesel tractors. Before we were through we found about 25 tractors that the prime minister didn't even know they had. It soon became evident that it wouldn't be necessary to rent tractors from Thailand. When dry, the soil was very hard --

Bainer: too hard for effective p lowing with oxen. This particular area floods during the monsoons. The water comes in rather slow, it doesn't build up all at once. It might be five or six feet deep by the end of the monsoon season. They plant Cambodia floating rice which extends as the flood waters come in. The rice grows in length to five or six feet. And I didn't believe this until I came home and asked the people in agronomy and they said there was such a rice. It floats on the surface and of course it's a mess to harvest. Well, what it amounted to we found 56 tractors already in use in Laos, so they knew how to use them. They knew what they could do, but there was nothing available in these colonization areas, and they really had some land clearing and some basic preparation of soils staring them in the face and they really needed the power. We visited places where there were going to be as many as ten thousand people relocated. In these areas they certainly needed power. Our recommendations were rather simple. They were to increase their tractors by 25%. We recommended that they all be one make and one size so that they could have an interchange of parts. Twenty-five percent of the value of the tractors was to be in spare parts. Also schools to train people to use these tractors properly and maintain them were suggested. The two diesels that I mentioned were being abused. The air filter, for example, hadn't been serviced. So we finally persuaded the operator to stop long enough so we could take the air cleaner off to see if it had been serviced. The intake pipe was choked down to an inch in diameter with dust. The dirt was going right into the engine. After we showed him the dirt, he drove over to the barrels for fuel. We assumed he would clean the filter but he never paid any attention. He just put more diesel fuel in and away he went. And here was this engine just grinding away on that dirt.

There were all kinds of arrangements. Some on a cash basis for plowing land, and others that were plowing the land for share of the crop. All they needed was power for land preparation. They could do the seeding and the harvesting and everything else by hand.

I visited a cigarette factory run by Chinese in Vientiane. That factory was just as modern as one in Carolina or Virginia. It had American and English automatic machinery. They were not only rolling all of these cigarettes by machine, but applying filter tips as well. They used a 25 percent blend of Virginia type tobacco. The cigarettes were on a par with some of the ones produced in this country. This was the only modern plant I saw in all of Laos. They had had help to build several other plants. There was a plant for manufacturing cement that

Bainer: never operated. A sugar factory had been put in but never operated. They could never keep anything running except as I say these Chinese operating the cigarette factory. They were growing tobacco with the aid of tractors and field machinery.

Well this flood plain amounted to about ninety thousand hectares. The floods came from the Nam Ngum River. The Japanese were assisting the local government in building a dam for flood control on the Nam Ngum River. When that dam is complete which I'm sure is by now, they can control the floods. As a result this land will be much more productive. I could see the reason that these groups of farmers were getting ahold of these tractors to get established on this plain so that when the water was under control they had their foot in the door and they then could really produce some rice. This one plain probably could have fed all the people in Laos. There's only a small population in Laos. There was no pressure for land.

Dickman: Were they able to make up this 60,000 metric ton deficit?

Bainer: I don't know. I've never been back and I was in hopes maybe I would be able to get back and see what had been done. We ran into some hill tribes known as Miao who were beginning to migrate to the valleys. This tribe is very wealthy, relatively speaking. They wear their bank accounts around their necks in silver bars. They make their money on opium. They were growing opium and marijuana, and mining some gold. The Miao tribe is a very restrictive group, I mean they're very close-knit and don't intermingle with the rest. Well, they were having to bring some of them down and let them start farming in new areas next to some of the other tribes, and they were worried as to how they were going to be able to get along. There certainly wasn't any intermarriage or anything like that.

I should mention that AID engineers helped the Lao farmers to build small irrigation systems. When it was demonstrated that, with controlled irrigation, they could produce as much rice on two hectares as they formerly produced on three, they only planted two. They felt no responsibility for feeding anyone beyond their village. There were no incentives because there was nothing they could buy with surplus cash.

THAILAND, 1966

Dickman: Did you consult in Thailand?

Bainer: Yes, I was a member of a team from Davis to consult with the Rector of the Kasetsart University in Thailand regarding the expansion of the existing college of agriculture, irrigation engineering, and veterinary medicine, into a full-fledged university involving everything we have at Davis except medicine and law. These were handled in other institutions.

Dickman: When was this?

Bainer: In 1966. Actually what happened in Bangkok, during the war, Dean Ryerson, who was quite active in the South Pacific, visited Bangkok many times and became very well acquainted with the director of the irrigation and power division of the government and this man's name was Xujati.

Dickman: How do you spell it?

Bainer: X U J A T I, and his last name is K A M B H U, but we just called him Xujati, and that was the pronounciation of his first name, [Sounds like "chew chat."] Well Xujati was a remarkable person. He was a dynamo! In the first place he was pretty close to the royal family. I don't think he had any royal blood in him but he was respected by the royal family. He was educated at the University of London, and received a civil engineering degree. He then returned to Thailand and worked himself up to a very responsible position in the government. Even though he wasn't a member of the cabinet or an official group he always met with the cabinet in their council meetings. He was a man that had borrowed millions of dollars from the World Bank to finance the building of dams and irrigation systems and the like, and they had paid the money back. Their credit was good. Xujati being a civil servant was forced to retire on account of his age I believe at sixty, but he wasn't through. He had a commercial interest in manufacturing in Thailand, in Bangkok. In order to keep him active they inaugurated him in 1965 as Rector of Kasetsart University. The fact that Ryerson had been there before and had been well acquainted with Xujati, he naturally came to the college of agriculture at Davis where we had experienced or were experiencing a rapid change from a college of agriculture to a full fledged university. He wanted to duplicate somewhat the same program at Kasetsart. So a team was appointed by the chancellor to consult with the Thais. This team consisted

Bainer: of Dr. Lawrence Andrews, dean of the College of Letters and Science, Dean Knowles Ryerson who had just retired as the dean of the College of Agriculture at Berkeley and had formerly been at Davis as the director on the Davis campus before we expanded, Milton D. Miller who was then the director of Agriculture Extension on the Davis campus and an assistant director statewide, and myself. The team went to Bangkok in June of 1966 to make a survey of the situation. Unfortunately I couldn't be with them the whole time because of pressure here, but I did spend some time there with them. I had previously visited Kasetsart and spent a couple of days there when on my way to Laos in April '66. I felt that maybe I shouldn't take the time to go at all, but Xujati absolutely insisted that I come even for a few days. So I made the trip out one weekend and back the next. And boy, I tell you twenty three hours on that plane with only an hour stops in Honolulu, Tokyo and Hong Kong I was bushed at the end of both trips. Xujati was very considerate. He sent a first class ticket and that helped. I really enjoyed the trip even though it was fast and furious.

My part of the planning was to look into the expansion of the existing irrigation engineering into a full engineering college. Irrigation engineering was not taught on the Kasetsart campus but was located four miles away where they had the headquarters for the irrigation department of the government. All the people involved in teaching irrigation engineering were also employed in other capacities in the Department of Irrigation in the government.

Kasetsart is relatively an old university. At least the buildings looked like it. Some of them were very antiquated. The campus was very near sea level. They had to do a lot of filling in to raise the level of the land around there to keep from flooding. Actually, I think they'd raised the whole campus about 18 inches by fill. Unfortunately, with the development of the airport at Bangkok, Kasetsart ended up being in the flight pattern of the airport and it was very, very noisy. After looking the situation over, the team felt that if they were going to go all out and develop a new university there wasn't enough room on that campus to do what they wanted to, and the surrounding area was pretty expensive land and it was low and it was in this flight pattern. The veterinary school was down town, and as I said, the irrigation engineering was in a remote location. So we recommended that consideration be given to buying some new land north of Bangkok and developing a complete campus there with housing for the

Bainer: faculty, schools, a church and hospital. It just meant the development of a new town. They of course had seriously considered this, and as a result the government bought 3200 acres of land 50 miles north of Bangkok. It's on a railroad, and a main highway -- well located. The distance from Bangkok made it unattractive to the faculty and staff. Typical of all countries, people want to live in the city, and to have to move from Bangkok out to the new location is like moving from Rio up to Brazilia. I mean the people just didn't want to do it. There was practically a rebellion of the staff against this move, and Xujati had his hands full. One of the problems with Xujati was he had had his iron in too many fires. He really never devoted the time that he should have to the development of this university. I remember at one of my conferences with him I specifically asked him (I was worried about this), I specifically asked him "How much time are you going to be able to devote to this expansion?" "Oh," he said, "it'll be enough." I said, "Specifically, are you going to work one day a week or two days a week? Are you going to be available say Tuesdays and Thursdays every day every week?" And he thought he might put that much time into it. Well Xujati being a dynamo and involved in so many things before this project really got off the ground had a heart attack and died. So, that left them without a leader and I just wrote the whole thing off. I just figured this thing wasn't going to develop now that Xujati was gone. I couldn't see anybody else in Xujati's whole staff that could pick up and gather up all the odds and ends and develop this project. So, it apparently lay dormant for a while.

Well anyway, of course, in our development there -- Andrews was interested in the basic sciences and made his recommendations as to beefing up these courses and development of their staff, and I of course was responsible for engineering and I actually layed out a complete program for an engineering college patterned pretty much after our development at Davis. We'd been through the same thing when we expanded the agricultural engineering department into a full fledged college of engineering. And I had had similar experience in Peru. So Kasetsart was just a rubber stamp of what we had done at the other two places. It consisted of a program that included agricultural, civil, electrical, and mechanical engineering. They weren't ready to go into chemical engineering at the time. I recommended that it be considered at a future date.

Dickman: Did they have an engineering college in Thailand at all?

Bainer: Oh yes, they had the Asian Institute of Technology (AIT) that was progressing very well. I visited it. It was headed up by Dr. M. E. Bender, Jr. from CSU at Fort Collins, Colorado. They were doing a good job at the master's degree level. They also had a college of engineering in the main university but I never visited it.

The problem at Bangkok was somewhat similar to what I ran into at Peru in that their basic courses in mathematics, chemistry, and physics and so forth were not strong, and they had to be beefed up. I indicated also that they would have to recruit people that were well qualified to teach engineering subjects, much as we did in Peru.

They did have some good engineers in the irrigation division, and they probably could have been worked into more responsibility. But if they moved the campus to new location, then of course they wouldn't be available, because they were already tied in with the national development. I suggested a program that was more or less a common core for all engineering students through about two and a half or three years with an upper division program which would be made up of electives, technical electives, in which the students could develop a program in their particular area. I also provided for a fairly largely portion of the program in the humanities, which they didn't have at all in their irrigation department. I recommended that the college of engineering be located on the main campus along with the physical science development, and that they'd have to develop a library. The library at the irrigation center was entirely inadequate. It had so much duplication in it. For instance I found out that they might have 20 copies of a book and then this book was loaned out for students to study rather than have them buy the book. The problem there was the same as in South America, in that very few of these text books are in the native language. This is always a problem when you're bringing in new materials such as they'd have to. Much of it would be in English, German or Russian. We recommended that the veterinary school be moved to the new campus. We all had in the back of our minds that if they were really going to go ahead with the program and spend the money that they felt they were going to be able to scrape up one way or another -- a loan from the World Bank or from their own local government, that they should give every consideration to building at a new location.

Well, as I mentioned, the plans laid dormant for some time. Only yesterday, which was March 13, 1972, we had a visit from the new director at Kasertart who was Prince Chakradandhu, and

Bainer: he had with him professor of agricultural economics Makajud, and one of their main reasons for coming here -- they just returned from Washington, D.C., where they have been in contact with the International Bank, to arrange for a loan to continue the development of Kasetsart, and these gentlemen came here yesterday for just a short visit with the team that was out there in 1966, and wanted to express their appreciation for the recommended plans for developing Kasetsart, and especially for the recommendation to build the university at a new site. They also wanted to inform us that they were now in a position to go ahead. This surprised me to no end because, as I say, I was discouraged as to what had ever happened out there. We were told that a provision for something like thirty man years of time is included to bring in consultants and experts and I suppose faculty. I hope that they also provided for fellowships for the existing staff to go abroad and continue their education. Of course they have a very good graduate school that's serving all of Southeast Asia now, right there in Bangkok, so some of the graduates could continue their education.

Dickman: What's the name of that school?

Bainer: It's AIT (Asian Institute of Technology)

They've just moved to a new campus, and it's supported by a number of countries, and I know that one of the big enrollments at AIT was from the Philippines. They have students from other Southeast Asian countries. They've done a very good job there in developing this program and it's a down to earth sort of a thing. I went over to visit to try to get some idea of the availability of some of their graduates for teaching at Kasetsart. I was told that these people coming through with a master's degree, most of them in civil engineering, were in such demand around that section of the world at salaries of two or three times what Kasetsart would be able to pay. They doubted if very many of them would be interested in teaching. This, of course, is one of the stumbling blocks in the development of Kasetsart, and in our recommendations we certainly suggested an improved salary schedule to attract and hold their qualified people.

Dickman: Did Kasetsart have a veterinary school?

Bainer: I wouldn't say it's too strong. They need help there, too. They need to get out of the city. As I understand it, when they move out of Bangkok, the facilities will be turned over to the medical school for training dental students. [Laughter]

Bainer: They're going to probably have to do quite a lot of remodeling, but that's how they expect to use the school facilities.

Dickman: With monsoon rains, why did they emphasize irrigation?

Bainer: There is a long dry period every year. You see, with irrigation in that section of the world, you can grow two crops a year, and this is exactly what we found out in Laos. There were a couple of agricultural engineers working in Laos which would be very similar to Bangkok (and I'll use this as an example). These two ag engineers demonstrated to the Lao simple rock filled dams to divert water from streams, and showed them how to lay out ditches to get the water out over their land. With irrigation they could get two crops a year or even improve the one crop they were producing--certainly in dry years. But say get two crops a year.

The interesting thing was that with fertilizer program and new rice varieties that were coming in from the International Rice Research Institute (IRRI) in the Philippines, they demonstrated to these farmers how they could improve the production of rice and have a surplus. This would help feed people in cities like Vientiene. Well, the Lao farmer doesn't have a nationalistic viewpoint. He's interested in his village, his family, and as long as they have plenty he sees no reason to have any left over. There's nothing (even though he's paid for this rice) he can buy. And so I've always mentioned the fact that they should have some incentives available like bicycles, transistor radios, sewing machines, and things that they might like to have but that are unavailable to them. So why have a bunch of money in your pocket if there is nothing to buy?

What happened was that these farmers in Laos, and I imagine the same thing would happen in Thailand, as soon as they found out that they could produce as much on two hectares as they used to produce on three, they only grew two, and the land just lay idle. You can't blame them too much because it's pretty hard work the way they go at it, and as a result they just eased up on their work load to produce enough for their village so that every body was fed. Of course, the object of the whole program was to get some surplus rice to take care of the big import that they were facing. Well anyway, that might happen in Thailand. I don't know. I think that Thai people are a little more progressive than the Lao , but this could happen in remote areas. In talking with the Rector yesterday, I questioned him about the introduction of the new Mexican wheat that came from the Rockefeller

Bainer: Foundation Research Group in Mexico, and the new IR-5 and IR-8 rice variety that came from IRRI which is the International Rice Research Institute which is also financed by the Rockefeller and the Ford Foundations. He said that they had brought these varieties in, but they had to adapt them to their region. They had used these new varieties as a base for cross breeding with some of their own varieties to make them more disease resistant and more palatable. There had been an overall gain in yield, and another thing that's happened there is that they're going all out for corn (maize) production. I think last year he said, they had exported a million tons of corn which is quite an accomplishment.

In the development at Kasetsart, they hope to develop home economics, and also expand the agricultural extension service. This would put the university within reach, you see, of the outlying areas, and make it better able to serve the problems of the land. It's going to be a long-time proposition to get that university really going.

Dickman: Do the Thais and Laotians like polished rice like the Japanese, or do they like brown?

Bainer: No, they like polished rice.

Dickman: They all like polished rice. Why?

Bainer: Did I explain to you about my question? I guess I didn't. When I was in Japan they were short of rice -- Well one of the questions that I asked continually as I moved around Japan, was "Why do you take the bran off of the rice?" Our preference here in California is for brown rice -- many people prefer it, and the rice goes further. Because, when you take off the bran you're taking off ten percent of the weight. The removal of the paddy coat takes off 20 percent and the removal of the bran and polish takes off another ten percent. And of course you take off a lot of the nutrients. And the answer I got continually was "It tastes better." And that was the only answer that I got I bet you 15 or 20 times when I asked this at various locations in Japan. Finally I was up on the Japan seaside. I think it was up near Niigata where I asked the same question. And so I asked an old gentleman, "Why do you insist on having polished rice?" And he said, "Well, first it tastes better, you see." And then he broke down. He said, "You know, during the war when we were really short on food, we attempted to use the brown rice, and since we have such a high concentration of starch in our diet

Bainer: we began having digestive problems with that bran, and we didn't have enough other things to go with it to give it a balance, and I found that I couldn't pack enough of that brown rice in my stomach to last out the day. I just couldn't get enough energy to do a day's work out of it." And this was the first time I ever got any kind of a logical reply. But I think it's just a matter of taste. These new varieties that come out of IRRI having been accepted because of yield--I mean the yield is way up on them. The rice has to be fertilized and irrigated to get this yield. It isn't acceptable to many of these countries because it doesn't taste like they've been used to, you see. And then of course the other thing is that you've got to be careful because when you begin to spread it around over the world you run into diseases and insects and other things that you may have conquered partially with the varieties that you have. And so there is this breeding going on using this as a base, so that's pretty much the way it is.

INTERNATIONAL RICE YEAR, 1966

Dickman: It was the same year -- '66 -- that you participated in the International Rice year, did you not?

Bainer: Yes, actually, I received a special delivery air mail letter when I was in Vientiene, Laos in April of 1966 asking me to be a delegate from the United States to the International Rice Year. When I got there I found that I was the only delegate from the United States. They wanted me to give a paper on the evolution of rice mechanization in the United States, which was pretty much down my alley. After all, I was involved in the very first combine -- direct combining, artificial drying in the U.S. The date of the meeting was the last week of September and the first of October.

Dickman: Where was it held?

Bainer: It was divided at two locations. I might say that it was sponsored by Food and Agriculture Organization of UN. Massey-Ferguson Company underwrote the cost. I don't know how many thousands of dollars, but a sufficient amount of money so that they could bring two hundred delegates from all over the world -- with all expenses paid. While we're on expenses I might say I was gone from home about two weeks. First Massey-Fergusson wanted me to come to Toronto and spend a couple of days there. And then we went to Coventry where we held all of the formal talks, and had some demonstrations. And then we went to the Po Valley of Italy for some of the demonstrations and to look over the experiment stations and to see some new equipment that was being developed for the smaller farmer for harvesting. I might say that I made this round trip to these two countries and home and I never had a chance to buy anything because we were in the field all day and at night the shops were closed. By the time I came home I found out that I had spent $12.85, for two weeks in Europe. So that was a pretty cheap trip.

What happened was that they brought in people worldwide -- Japan, Asia, the Philippines, Australia, Africa, where-ever rice grew they had delegates from there. And one of the most impressive things was that every delegate spoke English. Can you image it? Two hundred from all over this world and everyone spoke English. There was no need for any interpreting and everyone could visit with each other. You see this was most significant. And when we were busing around through the country when you sat down next to a guy from way out some place, you could visit with him. All of the talks were given

Bainer: in English and they were all published. In other words there was a book put out by Basil Blackwell, Oxford, England called the"Mechanization and the World's Rice." The papers centered around mechanization, even though there was very little mechanization outside the United States. There was some in Australia and Italy, but none in Asiatic countries.

Dickman: Does Massey-Fergusson sell internationally?

Bainer: Yes, they're an international company, and they're very competitive with International Harvester Company worldwide. They have a variety of machines. After they got through with the introductory remarks, they got into problems for rice production, paddy rice production, upland rice production, breeding to improve rice production, research in rice in Iraq, irrigation of rice in Italy, new production techniques and chemical aids in rice pest and disease control. And so we really didn't get into very much mechanization. There wasn't much mechanization to talk about.

There was an interesting paper given by a fellow by the name of Peterson on the economics of mechanized rice production.

Dickman: Where was he from?

Bainer: He was from Canada, he was an economist. He really wasn't from a rice producing area, but he worked for Massey-Fergusson worldwide, and he had observed a lot of rice production around the world and had made some economic studies for Massey Fergusson. An interesting thing. I just want to quote one figure from his paper. He compared the cost of producing an acre of rice in the United States with a conventional growing area in the Far East. Where the cost of labor per hour was two dollars in California, the cost per acre amounted to about seventeen dollars. At eight cents an hour in the far eastern countries, he showed a cost per acre of seventy dollars. That means a lot of people don't get anything for their labor, actually. This just absolutely amazed me. I fortunately had an up-to-date (1966) study made by our ag economics people on the amount of equipment that was needed to farm three hundred acres of rice. The bare cost of the equipment ran $118,200.00. Well boy, this just scared everybody when you told them. I was giving a picture of the United States and was way out on cloud nine as far as anyone else was concerned. And when you got through with the total cost involving labor, fuels, amortization of machinery, interest on the investment, overhead, land, tractors and equipment, buildings, taxes, and

Bainer: the whole works, to produce six thousand pounds of rice per acre on the three hundred acres, the cost ran $237.00 per acre.

Well, you wondered how they'd make any money. And, they don't make a whole lot if you're on that basis because -- you see, I had to do a lot of research to prepare this paper, because it was quite a while ago that I had anything to do with rice. So I really studied the literature, and I came up with some surprising information. For instance, I looked into the price that farmers received for rice over the twenty years prior to 1966, and the average was four dollars and ninety-three cents a hundred pounds. It just hung around five dollars, and there just wasn't any change. At this price, the total income for an acre was calculated to be $295.90. When you subtract the cost of $237 from $295 you come up with a net income of $58.00 dollars an acre. And so sometimes you wonder, if you had a hundred and eighteen thousand dollars, whether you'd better buy some high yielding stock or put it in a savings bank and forget about farming and all the gamble that goes along with it.

Dickman: Yes, that's about a five percent return on your money, isn't it?

Bainer: No. It comes to almost 20%. Well anyway, I, of course, went into all the phases of rice production including the seeding, fertilizing, and spraying. The costs in 1966 for airplane services in California were:

Seeding --	1.25 cents per pound
Fertilizing --	1.0 cent per pound (under 300 lbs/A)
	0.8 cent per pound (over 300 lbs/A)
Spraying --	20 cents per gallon (5 gal. or over/A)
	$1.00 per acre (under 5 gal/A)

I went into airplane seeding, direct combining, and artificial drying. I mentioned of course that C. M. Cerati of East Nicholas, Calif. had brought his dryer in from Italy in 1927. And believe it or not, when we got to Italy, I was in the town where this Cerati dryer was developed, and I visited the plant, and the farm where Cerati grew up and left his folks behind and went to California and set up a new operation. A brother was the inventor of the dryer that he brought to California.

Bainer: The Po Valley was a beautiful, beautiful farming area. One of the impressing things, I felt, that came out of this meeting was a small self-propelled combine that took a six foot cut. It was being developed for developing countries, by Massey-Fergusson. It was on tracks. It was very portable. It gave a good demonstration under some real tough conditions. This was high yielding rice, heavy straw. It had levees to contend with, and here was the first small rice combine that might be within the range at least of some operations in the developing countries.

Dickman: Is this why you went to the Po Valley?

Bainer: Yes. Of course, they wanted them to see the combine and dryers. They also wanted us to visit the experiment station, and spend time going over what they were doing in rice production.

Dickman: Is rice an important crop in Italy?

Bainer: Oh yes, it's a tremendously important crop in Italy, and in the Po Valley I don't know just what the acreage is, but it's significant. And here we were in October and the water was coming down out the Alps. The rivers were still running full of water, so they weren't using anywhere near the water that was available to them from the rivers and streams around there.

Dickman: Is the coldness of the water any problem?

Bainer: Yes, I imagine it is. It is here. This is one of the problems that is developing now with our gravity water we get out of the river. With the big dams at Oroville and Shasta, that are several hundred feet high, the water that's coming out of the bottom is cold. This is an important factor, and of course, one of the reasons that we are seeding in the water. Preflooding of the rice paddys permits the water to warm up before seeding. We don't like to have water in the paddy too long, because if we get a strong wind, it'll whip up waves and wash levees out and you're back where you started. So the object is, of course, to get the rice up as soon as possible. As the rice comes through it breaks the wave action, then you're out of trouble.

Dickman: Are these plastic levees an improvement?

Bainer: Yes they are, and I would say that the plastic levee has a place, but it hasn't been accepted to a great extent. We haven't got a plastic that's biodegradable yet. So you've got a problem of what you're going to do with them when you're

Bainer: through with them. Originally the machines that formed earth levees built them two and a half or three feet high, figuring that the wave action would reduce their height. With the plastic levee you could get by with half that height, and not have the problem of washing them out.

Dickman: Was there a connection between the International Rice Year and the IRRI in the Philippines?

Bainer: None, this was FAO United Nations sponsored. We had people from the Philippines there, but no relationship.

Dickman: Were there any results from this International Rice Year that you know of besides the six foot swath combine?

Bainer: Well that was probably one of the most significant things that was shown. Of course you never know what the far reaching affects are going to be of any of these conferences. It's just like the one we had at Chile. Out of that came the agricultural engineering program at Peru three years later. So you never know. These people came from all over the world and heard all of the papers and discussions. They held this meeting out in the country which was a great advantage because it kept everybody together. There wasn't anything else that they could do. It was getting a little chilly and you liked to be inside in England especially. So, we had perfect attendance at all the lectures, and they had a very comfortable place to hold the lectures, and a good public address system, and plenty of time for questions and answers. It was just a marvelous experience to sit down with people all interested in one subject, you might say. And so I'm sure they took information home. For instance, after I came home I got a letter from a chap in Africa who wanted all references at the end of my paper. This indicated that he had a definite interest.

I felt out of place there, in a way. I felt, "Here I was from a country that puts only seven and a half man hours into the production of an acre of rice, and here we're talking to people putting in anywhere from six to nine hundred man hours. There was a man from Japan, and of course this gave me some new figures for Japan. They were down -- his figures showed that they were down from the nine hundred I found in 1948 to about six hundred hours now.

Dickman: What has made that reduction?

Bainer: Well, they're going to mechanization.

Dickman: They are?

Bainer: Yes.

Dickman: They've got more petroleum now?

Bainer: Yes, well they're buying it. They're in World Trade and so they can buy petroleum. He indicated that they were developing small combines and tractors and the like and they're pooling the farms. In other words, instead of every guy farming two acres and a half, why they're beginning to cooperate. So you never know what will happen. I would like to inject a side light on mechanization in Chile. We had a banker from Ecuador attending the school on mechanization. He was involved with some programs that the bank was financing in Ecuador. After the meeting was over, he came to me with a very sad expression. He said, "Mr. Bainer, we're two hundred years behind you people. Two hundred years. We have no chance of ever approaching this even in the rest of my life." He just felt so lost. Sometimes I wonder whether or not it pays to tell a glowing story, and yet I'm sure that it sets a lot of people thinking.

Dickman: Do you think that the example is a good one for them to aspire to?

Bainer: Well, they can't achieve it. I mean you set a program up, or an example of such as I did at this Rice Year. Who's going to be able to achieve it? They just can't do it. It's completely out of reach. Maybe somethings will come out of it. I'm sure that the Japanese are going ahead with mechanization, they're going to mechanize their rice production. I can just tell you that right now, and they're going to move machinery into other areas. But it shouldn't be moved in until there is a demand for the people they're replacing someplace else, because this would just upset the whole economy.

RETIREMENT ACTIVITIES

Dickman: 1969 appeared to be a busy year for you.

Bainer: Well of course I wound things up in the College of Engineering, and on June 30th because of having reached the mandatory age for retirement I retired. I felt I shouldn't stay around Davis and interfere with the new dean. An opportunity did come up for consulting. One of the things that I did insist on, and I got the chancellor to back me up, was to persuade Dean Garland, who was my associate dean, to stay on for six months through this transition period. I felt that Dean Garland could do them far more good than I because Dean Garland had been here almost from the beginning. He had been at Berkeley many years and had been chairman of two different departments plus associate dean and acting dean, so he knew the ropes in the university. He ran the undergraduate program, and that was where they were going to have the most difficulty in the transition. Dr. John Kemper succeeded me as dean and Dr. Don Brush succeeded Associate Dean Garland. At the graduate level, of course, John Powers was going to continue on, so I didn't worry about this so, when Mrak backed me up and persuaded Garland to stay on for six months, I felt that I wasn't running out on anyone.

ICAITI

Bainer: I'm sure if I'd remained in Davis those six months, I'd have been pretty busy answering questions. Well, the first opportunity of course was a project that I'd been consulting on in Guatemala. They called a meeting of this committee for July. This gave me a wonderful opportunity to pack up and leave. This group was called the technical advisory committee on food sciences and agricultural engineering to the Instituto Centro Americano de Investigacion Y Technologia Industrial. It went by the name of ICAITI. It was organzed a few years ago as a research group to serve the five countries of Central America that are in the Common Market. They had a very capable director by the name of Manuel Noriega Morales, and Noriega, was, as I mentioned very capable but easy going sort of a person. He had difficulty on the financial side because the various countries involved didn't come through with their allotments. They never did have full financial support even though when they started their budget required each country to put up fifty thousand dollars which wasn't enough, really. So the countries voted to increase their contributions to eighty thousand dollars a year. This was ridiculous because

Bainer: the countries had never met the $50 thousand dollar assessment.

Dickman: What countries were involved?

Bainer: Nicaragua, El Salvador, Costa Rica, Guatemala and Honduras. Panama wasn't in it --

Dickman: How about Mexico?

Bainer: No, not Mexico. Well, there was a man in Los Angeles who had developed an interest in Central and South America. He was formerly a corporation lawyer by the name of Peter Nehemkis. He decided to retire from law practice quite early in his life. I can't image that he was even sixty at the time he retired. He had spent quite a bit of time in Latin America. He wrote an excellent book, on his reaction to Central and South America. He made a contact with the Latin America Study group at UCLA to work on problems in Central America. In his travels, met Noriega a few times. He told Noriega what he was attempting to do, and Noriega invited him to develop a committee and come down there and help them. He said they needed help. There wasn't any question about it. Nehemkis came to Davis and contacted Dr. Chichester who was the head of food science and technology. Chichester suggested me as an agricultural engineer. I had lunch with Nehemkis one day and he was quite excited about some of the work I'd done in Peru, and he said I was a natural. You know, he was a good salesman. And they got ahold of Robert Pearl who is the extension specialist in food science and technology. Chichester, of course, knew some of the other people in the food science technology field. One of them was Arthur Prater, who had retired as the president of a food processing company. He'd been the president of the Institute of Food Technology, and doing consulting in the food industry, but he gave his time free, and accepted this appointment. The other man was Virgil Wodika who was vice president in charge of research for Hunt Food Industry. And a very sharp man -- a very, very sharp man. Wodika was a chemical engineer. The five of us plus Nehemkis constituted the advisory committee. We made periodical trips to Guatemala and had sat with the leaders of ICAITI and tried to help them develop research programs. We figured that since they weren't getting full financial support from the countries they should be charging a fee for their contributions. It was a kind of a combination of a research group and a bureau of standards is the best way I can explain it, because they did a lot of testing work of leather, food and textiles. A young fellow by the name of

Bainer: Francisco Aguirre was the technical director. Well, they had pretty good facilities, and fair equipment. They had gone overboard on some things such as radiation of food -- they already had set up a unit and had gotten some foreign support to do this radiation work which seemed to us to be way out on cloud nine. Well, the situation was that we met with them regularly, and finally it was decided that they should be going after AID and FAO money and possibly support from some foundation. They were doing work on freeze drying, fruit dehydration, fats and oils, and cereals and mixtures. They were trying to develop some high protein, cheap foods that the ordinary working people could afford to buy. They were also doing analytical work. They were doing work in pulp, paper, and leather. They had people involved in a natural resource program, geology and mining and they were trying to develop their metals and glass factories. So, it was quite a widely spread unit. I think one of the most successful things that we did down there was to hold a series of workshops in various areas. People from here went down there to coordinate the workshop, and they brought in people from small industry for a week or two. George Marsh and Sherman Leonard from food technology and Milton Henderson from ag engineering assisted in the workshops.

Well, that was my last trip to ICAITI. Actually what happened was that the project became totally involved in food technology. I remember one trip down there they had processed some vegetables, and they were going to taste it periodically. Fortunately they had not tasted it yet. Chichester quizzed them as to the temperatures used in processing. It wasn't high enough to destroy bacteria and he was just absolutely sure that botulism was involved. I remember him asking them to show him all the cans. And he said, "Now, they must all be destroyed. Not just taken to the dump, but they must be taken to the dump and punctured, and don't ever let anybody taste this stuff." It probably would have killed somebody. This is how far behind they were, you see, in processing. Well, it was an interesting experience to see how a research organization might be set up to serve a group of nations. The point was it's location being in Guatemala, it was almost solely a Guatamala operation.

Dickman: What was your opinion of the quality of their research people other than this fiasco on canning?

Bainer: Well, they just didn't have it. That was the main problem. It's going to be lifting themselves by the bootstraps and getting these people out for further training and education.

Bainer: Everything they did seemed like it was just about half-baked. We didn't quite get to the root of all their problems. I was talking to Pearl a while ago and they'd been down there. It's pretty slow. They're behind on the financing.

Dickman: Did they pay your expenses?

Bainer: Partially. Our transportation was paid out of the Los Angeles office, and I think that Nehemkis had some Ford money to start with. I never quizzed him as to where our expenses were coming from. The living expenses were paid by ICAITI.

Agrarian University of Peru

Bainer: I returned to Davis after that trip. Then in August the Agrarian University of Peru invited a group to come in under auspices of the U.N. special funds to discuss a graduate program in ag engineering. This was to be on top of the five-year professional program already in operation. So, in 1969, August, they had a kick-off of the graduate program. I think they were expecting only two or three graduate students in the fall. They had a number of people from the United States and even two from Europe there for a workshop. It was a very delightful experience, and I think it was an eye-opener for most of the people that came because they had no concept as to what the Peruvians had done in building up the agricultural engineering program -- the five-year professional program, and the physical facilities. And I tell you, when some of these people saw what had been done there in the development of a new campus -- new buildings, new equipment, and a program that was ongoing with four or five hundred students they were surprised. We even had people from the United States that would have been very delighted to have had those laboratories in their own university.

Dickman: Had you developed your own laboratories in that five-year period? You weren't using the laboratories anymore over at Lima?

Bainer: No, no. We had all of the laboratories and no further need for those at the University of Engineering in Lima. You see, the undergraduate program actually started in '61. Now it was eight years later. They had developed beautiful laboratories. They weren't fully equipped but there was plenty of room to expand. They had developed a staff that could handle all courses. At the time we were there we discovered that there were seventeen of the staff in the United States working on advanced degrees. It's been a

Bainer: tremendous development. Yet you just have to give the credit to the Peruvians. Of course, they had some help financially from the U.N. special fund. They also had help from the crew that was in there during the five-year period when we were trying to bring them up to the professional level. [Laughter] But, they had to do a lot of things for themselves and they really did. These people got out and got advanced degrees and now they can teach whatever they want to teach. They don't have to go out and get any help. They also had people from other countries in South America there for the workshop. The nearest competitor to La Molina is a program in Colombia. They have been assisted by AID and a crew from the University of Nebraska. Last week I was at Kansas State University and I found out that they had even loaned a man from ag engineering to the Nebraska team for work in Colombia. The Colombian program started about the time we finished -- and they are developing both an undergraduate and graduate program. The leaders from Nebraska that were down there on the Colombia project came to La Molina to see what was going on. I think they had their eyes opened. The next important center for agricultural engineering will be in Colombia. The country that I found out later that could probably use ag engineering more than any other country in South America is Brazil. They have nothing of significance in the way of a professional program.

Brazil

Bainer: After the trip to Peru, I returned to Davis and prepared for a consulting trip to Brazil. I went down there about the first of September and stayed three months. The work was done under the auspices of IRI research institute in New York City which is part of the operations of Nelson and David Rockefeller. It's a non-profit group that had a contract with AID in Brazil to make a study of existing experiment stations. And also to make studies of certain states in Brazil that didn't have adequate experiment stations, in an attempt to upgrade agricultural research. The team that I was associated with was made up of a professor from Michigan State University by the name of Kenyon Payne, who had been head of the agronomy department. The other member of the team was an animal husbandry man from Nebraska by the name of M. A. Alexander, who had been retired for about three years. Two of those years had been spent in Turkey at some agricultural institution. This team was assigned to study the needs and the status of agricultural research in the states of Parana and Sao Paulo. Fortunately for us these two states were the breadbasket of Brazil, and

Bainer: much further advanced than any other area of the whole nation. We had a rather delightful experience compared to some of the other teams that were back in the hinterlands trying to develop research programs. We spent about two months in the field. First making an aerial study of these two states to kind of get a general picture of the topography and the farming areas, the forests, the pastures and the like. On this aerial survey we even went down to Bage which is in Rio Grand de Sul, primarily to see a livestock station. It was out of our territory, but was credited as being the outstanding livestock station of Brazil. We thought it would be well to observe this station and see what we might pick up there that we might use of benefit elsewhere.

The state of Sao Paulo is more advanced than any other state in Brazil. It's a big state with an excellent university and many research stations. They have several institutes and an engineering school or two, and it was just head and shoulders above the rest of the country. Parana, which is the state to the south of Sao Paulo, is probably even larger than Sao Paulo state, but not nearly as fully developed as Sao Paulo state. Well, we were told at the beginning that Brazil was going to need more food, and the place to try to get this increased production was where they were already doing a pretty good job. They felt that these two states were out in the lead and with the proper reorganization and development they might be able to double their production in the next ten years. That was more or less the goal.

We observed several things, of course. One, that coffee production in Brazil had moved south from Sao Paulo state into the northern part of Parana, primarily because of the lack of maintenance of soil fertility in Sao Paulo. Apparently they had mined the soil and coffee production went down and down. Rather than trying to build and maintain the soil fertility, they just moved to cheaper land and started raising coffee down in Parana. Of course you're moving away from the equator when you move from Sao Paulo to Parana. They had a big freeze on July the fourth, '69 that almost wiped out their coffee trees. It didn't wipe them out, it just froze them down to the ground, and of course with the proper pruning and so forth they'd come up again from the roots. Fortunately, they had harvested the coffee before the freeze so they got that years coffee, but they were expecting to have a pretty short supply of coffee during the following two years. Well, its very evident that you're getting out of the climatic condition that's most suitable for coffee. They had a marvelous soil known as terra roxa down there and

Bainer: that of course gave them high production of coffee. In 1969 Parana produced 50% of the Brazilian coffee.

After making an aerial study, we made a preliminary trip over the area by car. Then we returned to Rio and wrote an interim report. We were then sent back to the field to try to reorganize their agricultural research program. After making our preliminary study, it was very evident that many of the experiment stations had been located politically, -- they weren't in typical areas. Even the headquarters station at Curitiba was poorly located. And so we made then a second trip by automobile all through that area trying to pick more typical sites to locate these experiment stations.

Dickman: Did you want them located near a university?

Bainer: Well, we hoped they would be, but it wasn't possible in Parana, because the only university was at Curitiba. For instance near Curitiba they had this poorly located central master station which was responsible for all agricultural research in Parana. About eighty miles away near Ponta Grossa they had an agronomy station which was doing really beautiful, beautiful work on irrigated and non-irrigated grains, and doing a breeding program, and making fertility studies and the like. It was a very adequate station with 475 hectares of land. It was level. A river nearby gave them irrigation water. They didn't have very good facilities -- I mean greenhouses and the like. But there was something being done. They were building a modern seed cleaning plant. Five miles away they had 3500 hectares for livestock investigation.

Our first recommendation was that the main headquarters for all research in Parana should be moved to Ponta Grossa where these two large experiment stations already existed. And then develop, at outlying points, field stations to serve commodities in the particular areas. They would be small. There would probably be a director and three or four technicians and they would be under the supervision, you see, of the headquarters station. It would be something like our field stations in California, but with one big headquarters. Another thing is that it would be close to Ponta Grossa which was developing into a big city. An agricultural college was in the long-range plans for Ponta Grossa. Well, this was in our report. Whether or not it will ever be accepted by the people of Parana that are running the show remains to be seen because there is this desire on the part of all these people to live near the center of things. And of course, Curitiba was the capital

Bainer: of Parana and had direct air service to Sao Paulo and Rio. These people just don't like to be stuck up in the country someplace even though Ponta Grossa is only an hour away from the airport at Curitiba.

Dickman: What U.S. firms were there?

Bainer: Well, there weren't too many. For instance, Massey-Fergusson, the Canadian firm, was manufacturing tractors in Sao Paulo, and Fiat, an Italian company was manufacturing tractors and machinery. They have several of their own machinery companies coming along. And of course, the big automobile producer was Volkswagen -- they had flooded that country with Volkswagens. I would expect that sixty or seventy percent of all the automobiles in Brazil were Volkswagens. You just never saw such a bunch of beetles in your life as you saw around Rio. Dodge was building some automobiles and trucks down there. Chemical people were in there mainly to sell fertilizers and poultry suppliers. But there wasn't a lot of agricultural machinery manufacture except by the Brazilians. Brazil has a tremendous amount of natural resources. They have some of the greatest iron ore in the country. For instance they make the Volkswagen from the iron ore up. I mean it isn't an assembly job.

Dickman: What's the state of the mechanization of agriculture?

Bainer: It varied a great deal. We saw the extremes. Up around Ponta Grossa, which is wheat and potato country, mainly, there were some enterprising farmers in there that were keeping in touch with the experiment station. One of them happened to be a brother-in-law of the director of the experiment station and we visited his farm. He had 1500 hectares in wheat and 250 hectares in potatoes. He was taking advantage of all the findings of the experiment station and was exceeding their yields on his own farm. And when you went out and saw these tremendous fields of wheat you thought you were in Kansas. He was flying selective herbicides on his wheat and it was free of weeds. It was well fertilized. It was combined by self-propelled combines.

Right after the war Brazil offered refuge for D.P.'s out of Austria, and four hundred families were brought to Brazil. Each family given twenty hectares of land.

Dickman: How much is a hectare?

Bainer: Two and a half acres, so that would be fifty acres of land. These families moved in and set up a colony, more or less,

Bainer: on the high plains area in south central Parana, near Guarapuava. The land that they gave these poor people was almost worthless -- no one was interested in farming it. But this didn't deter them at all. They brought an agricultural advisor with them to help with technicalities they'd be up against. They began to analyze their soils. They found them acid so they started burning lime and limed them, and they began to fertilize. Then they began to raise wheat, and now twenty-five years later, it's the showplace of Brazil and they were organized as a group of down and outers could be. You know they were fighting for almost the next mouth of food. They now have a complete cooperative. The houses are well-built. They have good schools and good roads. They have just finished their own flour mill. They have their own grinding plant for limestone. They have their own seed storage and seed processing and cleaning equipment. They developed two hydroelectric power plants on the river. They have been promised a railroad coming in there from the north -- about a twelve mile line to haul produce out. Otherwise they have to truck it out. They had something like 2000 tractors and 200 self-propelled combines. I know they bought twenty-four new combines from Germany in 1969. The interesting thing was that of the four hundred families originally, about a hundred and forty of these families just couldn't stick it out. They went to the city and got jobs and that left two hundred and sixty families. These two hundred and sixty families now have spread out and bought or leased land around this colony. Some of them who started with fifty acres are farming two thousand acres. And the people in the area, the natives have seen this success, and so they're joining the co-op. They'll send any qualified youngster out for a college education if he'll promise to come back and work for five years.

Dickman: Have they intermarried?

Bainer: They've stayed within their own ranks. But, it just shows what a group of people that are willing to work and have enough technical advice can do.

There was another colony -- a colony of Dutch up near Ponta Grossa that started in the dairy business. They had their own processing plant, which we visited. And, of course, having this Dutch ancestry, I tell you it was just spic and span. They were processing and delivering sixty thousand liters of milk a day in plastic containers -- a liter is about a quart. They also made ice cream and cheese. They milked by machine and brought the milk to the central co-op and it was processed and sent to the city for consumption.

Bainer: We visited another group of Japanese farmers near Basto. These farmers had gone into poultry business, and had imported all of the know-how, and I mean all of the know-how on poultry from the United States. They had two million chickens in a two-mile radius -- much more concentrated than around Petaluma. They could process 1500 fryers per hour. They eat lots of barbecued chicken in Brazil.

While in Rio we had meetings with different commodity groups like the livestock people and the vegetable people -- in the Brazilian government. We were told that there just wasn't any way of accelerating the fattening of beef. The best one could expect was a five-year period before you had a marketable animal -- five years to raise a calf to a marketable animal. Further they wanted four inches of fat on the back of a hog, and of course Alexander never agreed with that one. He said you couldn't afford to put four inches of fat on the back of a hog. Well, they wanted the four inches of fat because that was the source of lard for cooking.

One of the things that Alexander kept wanting to see was the carcasses of animals that had been through slaughter. That was one of the reasons we went to Boge. There was a big packing house down there. We went to the packing house only to find out it wasn't operating.

On one of our aerial trips we visited the Swift Ranch near Presidente Prudente. After spending the day at the ranch we returned to Presidente Prudente for the night. The next morning we were grounded by fog. When I was coming down in the elevator for breakfast, an American got on the elevator. Of course I saw him, he saw me, and if you see someone you think is an American you strike up a conversation. He was Mr. Harper, a consultant from the United States. He was at this particular location because the local farmers wanted to put up a tannery. They felt that rather than selling their hides from the packing plant to Japan, they'd better be tanning their own. He wanted to know what I was doing and I told him briefly and so he said, "Let's have breakfast together." So we went to the dining room and had breakfast. As I talked he said, "You should talk to my boss." I said, "Who is he?" He said, "Well, he is a farmer out here." And I said, "I'd be delighted to meet the man," but I didn't think about him bringing him around. Well, he called his boss who was apparently the chairman of the committee that was going to put up the tannery. And so he went down and brought him up to meet me. It turned out that he was a local man by the name of Joel Amaro Mascarenhas that had gone to Mississippi State and

Bainer: received a degree in animal husbandry in 1961. Upon returning he had married the daughter of one of the big ranchers who had died recently. So he and his two brothers-in-law were running a big operation. He was involved in the local packing plant as well as starting a tannery. He was a business man besides being a rancher.

Well, you know he got interested in our visit. So he called a taxi to take the consultant out to his job. He indicated that he would like to visit with us. We told him that we were grounded and that we couldn't leave until the fog lifted. He said, "Well we have a nice packing plant out here. Would you like to see it?" Well we were dying to -- we didn't know it was there, you see.

Here was a packing plant known as Bordon. I guess he was one of the directors. I'm sure he had some connection because all he had to do was to call up and we were in. We put on white coats and rubbers and were taken to this packing plant. Well this gave Alexander the first real look at the carcasses of animals -- that he was just dying to see because he'd heard so many rumors about them. Well to make a long story short, this packing house was the most modern and cleanest I had ever seen and I've been in packing houses in Chicago and Kansas City. In my earlier days we used to ship livestock to Kansas City. Well I never saw a packing house that was any cleaner and more organized than that one.

Dickman: What did Alexander say about that?

He was delighted as I say. The only thing that disturbed us was that the animals that were coming through the line with hoof and mouth disease were shunted out. This is one thing we couldn't tolerate in the U.S.

Well the point was that they were producing beef for export and they were killing a thousand a day. This beef was going to England and Germany and some for the United States. Before it came to the United States it had to be processed, canned. Beef going to Germany had to be boned. I found out that this packing house was subject to inspection at any undisclosed time. In other words the inspectors from the countries that were buying this meat could just drop in tomorrow and they didn't have any chance to clean up so they just kept it clean all the time awaiting an inspection. Well there were some things that were interesting. As I already mentioned the hides all went to Japan and that's what these local people wanted to start processing. All the glands from the

Bainer: animals went to pharmaceutical houses. They were making sutures out of the guts for Johnson and Johnson. All the stones that they found in the kidneys and the like -- stones of calcium, I suppose -- they were all going to Japan for jewelry. They were an enterprising outfit! The fact that we were grounded and didn't know what to do, actually our meeting the guy -- will show you that these accidents develop and this was one of the most profitable mornings we had in that country -- to see this modern packing house. To see how it could be done in a developing country. It was just as far advanced as anything we had in this country. And this farmer just stayed with us until the fog lifted and then took us out to the airport.

Dickman: Where do they get their sugar, all from sugarcane?

Bainer: Yes, they grow sugarcane. There are no sugar beets there.

Dickman: How about the forests -- have problem with fires?

Bainer: I don't know that they do have too much of a problem with fires. I suppose they do have. We traveled through a lot of blackened areas where a fire had gone through. On this same trip we flew to the southwest corner and saw the famous Iguacu Waterfalls. Very few people have seen them. They're far more extensive than Niagra Falls.

We had another accident (we were talking about these accidents happening). We drove to the town of Toledo. They were still clearing forests out there. They were developing grain and livestock enterprises. The Toledo area was known for the hogs. You see we'd been to the beef cattle area. The day we were there was a holiday. You run into these holidays, and the man we wanted to see was on holiday. There was a packing plant there that handled hogs. And having had one experience in a packing plant we just went up to the door and told them who we were and we were taken in by the director Pedrinho Antonio Furlan and given royal treatment. This was where Alexander found out that they wouldn't even buy a hog that had four inches of fat on his back. They wanted not over a quarter to a half inch. They had their own extension people out with farmers to advise how to produce hogs without all this extra fat. This packing plant was owned by the Sandia Airline Company. Actually we were told that the airline developed down in Rio Grand do Sul to haul processed meat to Sao Paulo and Rio. This was before they had railroads and decent highways. So the son of the owner of this packing house just said, "Well, Dad, we'll just fly them out," so

Bainer: they developed an air freight line to handle all their processed meat. Then when the railroads and highways came in this freight line was converted to haul passengers. It's one of the air carriers in Brazil. They're still in the meat business and also in the airline business.

But it was comical. You know Alexander went back and told this animal husbandry specialist, who had never been there, about the lean hogs. This is what you run into with a lot of government officials. These guys are in there because of politics and don't even know what's going throughout the country. So Alexander told this guy, "Those people wouldn't even buy a hog that's got four inches of fat." It embarrassed him , Alex was the guy that could embarrass him, because after all we were given all these bum steers.

One of the things I failed to mention was the Swift Ranch was owned by the Swift Company and King Ranch of Texas. You can find King Ranches about everywhere. I find them in Spain now. They're all over the world. They had cleared the brush by dragging a chain between two tractors. This chain was a hundred feet long and weighed twelve tons. They pulled each end of the chain with Cat 60 tractors. The chain broke the brush off as it was dragged along. The brush was raked up and burned. They had developed supplemental pastures. See, there's a dry spell in Brazil. During the dry season they just let the animals go down in weight. They don't feed supplements. If you plot the weight gain of an animal it goes up in the growing season and down in the dry season. Then next year it goes a little higher, and finally after five years you can get them up to a size where they're marketable. Well this Swift Ranch showed how they were raising supplemental feed. There was some irrigation developed there and they had put in permanent pastures and were growing fodder crops that could be ensiled. They were feeding animals through the dry period and instead of taking five years to produce a marketable animal they did it in three. And this, of course, was in our recommendation, that they supplement the feeding of animals so that they could get them through these dry periods and get them in the markets in a shorter time. Well you see, if you could cut two years off the production of a market animal, you could increase production by forty percent right off the bat.

Dickman: Where did you stay when you were there? In hotels, primarily?

Bainer: Primarily hotels and with one exception they were delightful hotels. Most of them were new. See, this is a newly developing

Bainer: country, and I think the first surprise was the trunk line highways. They'd all been built in the last five or six years and they were all built to U.S. standards, all asphalt. And the main reason that they were built was to get coffee out through a port in Parana, and not have it go out through the ports up in Sao Paulo. They felt if they were going to produce the coffee they should handle the coffee and market it through their own ports. So they got busy and they built -- new highways to link up all the important centers in Parana.

Jim Haynes of the IRI office in Rio was our tour guide and interpreter on our trip to Bage. It was far back in the cattle country in the state of Rio Grand do Sul. Haynes had never been there. He made the remark, "Well, we're going to fly down to Bage, and it's out on the perimeter. I don't know what we're going to run into." So I took mosquito repellant and netting to sleep under. I figured, "Well we're going to rough it." We got down to Bage and this experiment station told us to circle the station and they would send somebody to the airport to pick us up. And as we circled the experiment station we also circled the town. The first thing that I saw was a twenty story building. [Laughter] Finally we were taken to the hotel and it was a brand new six-story hotel. It had elevators, modern air conditioning, all the rooms with a bath. The rate was five dollars in our money, roughly five dollars a night for bed and breakfast. We went down to dinner in the dining room, and I am not lying to you. We had filet mignon steaks served to us that were at least two and a half inches thick for $2.75 a complete dinner. [Laughter]

Dickman: Was this typical?

Bainer: This was typical. This was the funniest thing. I never ate so much meat in my life. And then when you moved out into the rural areas you ran into what you called the Charascuria where they barbecued steaks. They'd start a fire along about nine o'clock in the morning and by noon they had quite a bed of coals and they barbecued over them. And you'd go into this Charascuria and get steak and potatoes. They barbecued the steak on a spit -- an iron rod that was maybe three or four feet long. They'd bring that from the barbecue and set them up vertically in bricks with holes in them right on the table. You carved off what you wanted. And it didn't take you very long to know where the tender pieces of meat were. If you wanted anymore they just cooked more at no extra charge. As I say, I lost nine pounds eating filet mignon. That's the best way to lose weight I ever saw.

Dickman: How were vegetable crops?

Bainer: Yes, there was quite a few vegetable crops. There were beans and tomatoes. They sold lovely vegetables. I think the thing we appreciated the most was the pineapple. I've never tasted such wonderful fresh pineapple as we had down there. Of course that was what we had for dessert time after time. And the bananas were good, they had a little different taste than the bananas we get here. And the seafoods -- when you got along the coast the seafoods, especially the shrimp, were very delightful.

Just as a sample, we spent two different periods in Londrina. Londrina is in the coffee country in Parana. It's a town that's probably gone from nothing to a hundred thousand in twenty years. You never saw such a skyline. You just can't believe it. Well we stayed in a hotel there. As I say, we were in there twice, and when you went to your room it was air conditioned. There was a refrigerator in every room, and in every refrigerator was anything that you'd anticipate you'd ever need from Coca-Cola, beer, mixer waters, ice, and on the shelf was two kinds of whiskey and gin. You used what you wanted and then in the morning when you checked out they inventoried your room and charged you for what you used. Well sir, we sure liked that hotel because when you wanted a coke or a beer when you come in, there it was.

Dickman: How was inflation? Was it bad?

Bainer: Oh yes, the exchange rate changed while we were there. The currency exchange kept going up and up all the time. But Brazil is a great country. It's half as big as all of South America and it has half the number of people. And it's just as different as night and day from the west side of South America. See, all of my experience was in Guatemala, Peru, and Chile. I always was going to come home by way of Rio at some time or another but I never made it. Well now I went into a country that I just didn't believe existed. The potentials of that country -- they could feed all of South America. There are plenty of problems in Brazil, especially up in the northeast section of the country, but the point is that they've got a potential there that just hasn't been touched. There was an interesting thing. As you know, they've built a new capitol at Brasilia, and no one wants to live there. I came back that way and I can see why they would hate to give up Rio and the Copa Cabana and all of the other things that are attractive around Rio. Brasilia is way out there on the plains -- there just isn't anything very attractive about it

Bainer: except the buildings. There's quite a bit of business done out of Brasilia. Many of the people that work in Brasilia still live in Rio and fly home every Friday night and come back Monday morning. An edict came through on the first of December that the whole Ministry of Agriculture and all of its sub-departments would be moved to Brasilia on January first. And what happened? Every department head resigned -- en masse. So I still don't know what's going to take place there.

I'd like to go back and see if they're doing anything. We suggested the relocation of practically all the experiment stations and the closing of the weak ones in Parana. We also recommended that nothing be done in Sao Paulo except an assistance program from the federal government. Sao Paulo was so far ahead of the rest of the country in agricultural research that it was ridiculous to suggest anything that might be done there other than give them federal support. This would be more or less as the USDA does -- furnish some funds and manpower to augment the local stations. Our whole hope was to bring Parana up to the level of Sao Paulo.

Spain

Bainer: I was working for the IRI research institute in New York. They had a contract with AID. I don't know whether I mentioned that IRI doesn't stand for anything. It's just simply three letters they have in their name and it's a non-profit organization that is headed up by the Rockefeller brothers -- David and Nelson Rockefeller, mainly. They actually have two organizations. One finances different endeavors around the world for profit. The other is philanthropic. The latter will take a contract with some government agency to do a specific job.

In 1971 the Spanish government, through their Minister of Agriculture, developed a project for revitalizing agricultural research in Spain. They made an application to the World Bank for part of the funds needed. A team, under the direction of C.P. McMeekan, made a study throughout Spain to arrive at a justification for this loan. The project finally wound up to be in the neighborhood of twenty-eight million dollars, and the loan was for about eleven million. The government of Spain made a contract with the IRI research institute to assist with the development of facilities and with the selection of experts to be brought in for a period of five years.

Bainer: The project consists of organizing six research centers that are commodity oriented. One is for oil seed crops including olives. This station is located at Cordoba in South Spain. They have already selected a research coordinator for that station. He is Dr. Wally Sackston, a professor of plant pathology from Magill University in Canada.

A second center at Valencia is designated for citrus. There was an old citrus station there but I'm told that it was so inadequate and the area was so limited that they figured they should start over. So they are buying a citrus orchard and developing a facility there. The research coordinator selected for that project is Walter Reuther of Riverside who left the University and accepted this position for five years at Valencia. I think this is a very fortunate choice in that the diseases in citrus in Spain are quite similar to those found in California. The Riverside Station has answers to many of these problems so that Reuther should be able to make a pretty good showing there.

Dickman: Do they have both Valencias and Navels?

Bainer: Yes, they do, and a very good tasting orange. While over there I had oranges for breakfast just about every morning and I'd say they're very good. One of the problems I'm told is that they do not have a system of quality control so they're letting oranges of inferior grades get out of the country. They're finding that they're not competitive with oranges from either Israel or the United States.

A station at El Encin near Acala which is only twenty-five kilometers from Madrid, is going to be devoted to small grains and legumes. The research coordinator of this station, a soils professor from Purdue by the name of Joe Vavara. He is not only the research coordinator at El Encin, but he will also be in charge of soils work throughout Spain. Incidentally he was on the IRI team in Brazil when I was down there.

One livestock center is being developed at La Coruna, which is in the humid area on the northwest corner of Spain. This station is going to be devoted to the production of livestock, three general classes -- beef, dairy and sheep. They have already hired Aden Conway from one of the agricultural colleges in Ireland as research coordinator.

The other livestock center is at Badajoz which is down on the Portugal border in an arid area. This center already has a new building. As a result, its further development will await

Bainer: the building of the other centers. A center for vegetable crops is being planned for Zaragoza.

Dickman: You've been to all these others?

Bainer: No, I have concentrated on Cordoba, El Encin and La Coruna. A professor from Newcastle in England by the name of Cooper has been hired as overall coordinator or director for all of Spain. Initially the direction came from Dr. McMeekan who was instrumental in conducting the original study for the World Bank. McMeekan had a long background of this type of work in that he had been with the World Bank for about twenty years and told me he had worked in forty-four different countries. He was to head up a team of three that would have visited these projects for the World Bank about every six months. Unfortunately, he was drowned in a boating accident. I don't know who will conduct the follow up review now.

My initial assignment in this overall project was to develop research facilities. I went there without any background information whatever. I had available to me, upon arrival, the report of the original committee that made the studies. It was a very all-inclusive report in which they indicated the amount of money to be spent for facilities, furniture, laboratory equipment, and farm equipment. They also listed the number of people needed in the administering of each center, and the researchers that would be involved in carrying on a research program. And from this list I was able, then, to make up a master list of staff and technicians for each center. Using that list I determined the types of laboratories that were needed at the various locations and drew up a sketch of the arrangements of offices and laboratories. Each center will have an auditorium that will seat a hundred, a cafeteria that will feed a hundred, and a library and administrative offices. One of the things that McMeekan insisted upon, and certainly I agreed with him, was to have the offices adjacent to the laboratories so that when these researchers went to the office everyday they were next to where the research was being done. He said, "You ought to make it so they couldn't even get in their office without going through the research laboratory." Well, this isn't common in Spain. The research laboratory is in one general location and the offices of course are in the other location.

Dickman: Is the architecture the same for all of the stations?

Bainer: No, the architecture will not be the same. A firm of architects was hired to prepare preliminary sketches on each to show the general layout. We were very fortunate with the architect. He really was an artist with great imagination. I was so pleased when I saw the first preliminary sketches because all I had done was just a blockout. It showed the arrangement of offices, laboratories, cafeteria, library, and the like. I had selected a module for the basis of design. This module was two and a half by five meters. Everything is in the metric system over there. Two and a half by five meters would give twelve and a half square meters as a module. I selected this as the correct size for one office, for example, so all I had to do was lay out the modules for the offices. If you convert that over to square feet that would be about a hundred and thirty square feet as an office. I had a little difficulty to start with the Spaniards. They felt that these were too small. Most of the offices I had observed were a hundred and fifty square feet or more. This was large enough to put two or three people, and that's what I found in these offices. I sold this small module on the basis that it wasn't really large enough to put two people in. Everybody was going to have his own office.

This module of two and a half by five which gave twelve and a half square meters made a very respectable sized office. In fact, it is just about the size of the office that is standard in new construction at Davis, about a hundred and twenty-five square feet. Then to develop laboratories, we put two modules together for a small lab which would give you twenty-five square meters or roughly two hundred and fifty square feet and three modules gave us the large lab of thirty-seven and a half square meters. Then, of course, when you get into administrative offices like the director, we put two modules -- gave him two modules. Well, it was interesting, the reaction. I presented my preliminary sketches to Dr. Tellez who was then president of INIA which was the National Institute of Agronomic Investigation. It's part of the University of Madrid actually, it's the agricultural end tied in with the university. Dr. Tellez' first reaction was everything is too small - everything. He said that INIA had their own architect who had done some preliminary work, and that he wanted his own architect to take this material and combine it, consolidate it and rework it. And I thought "Well, here's my first defeat, here I am ready to go into the preliminary planning stages and criticism is coming up that things are too small." I didn't argue with them -- after all they were paying the bill. I could see that there was liable to be a lot of waste space in these buildings. Mr. McMeekan heard this criticism and walked out

Bainer: on me. He said, "This is your problem, get the thing resolved." Well, this was in the morning and Dr. Tellez said, "At six o'clock this evening you come in and we will have this combination fixed up and talk about it." Well, Mr. McMeekan went home and left me there, and at six o'clock nothing happened. Dr. Tellez wasn't available. At seven o'clock he still didn't show. I finally found his secretary and said I had a date with Mr. Tellez at six and where is he? I thought I should have an explanation. After all I was waiting around there just killing time. She said, "Dr. Tellez had a very important visitor come in." And this happens all the time. Visitors are more important than anything else it seemed like. So she went in and reminded Dr. Tellez that he had this date with me. He came out and apologized and said that this important visitor had come along and he had to take care of him. And I said, "Maybe you'd rather wait until morning." He said, "All right, nine o'clock in the morning." So I found a car and went back to the hotel. I came back at nine o'clock and rapped on his door. He said, "Come in," and I just went in. [Laughter] I wasn't going to wait for any important visitors or anybody else. What happened in the meantime I do not know. Over night something had changed abruptly. He started in by saying, "Now, I'm going to hire an outside architectural firm," and started to write down instructions. He said, "He will prepare preliminary floor plans and elevations of the building that Mr. Bainer has laid out here on this piece of paper, and these plans should be ready within two weeks. In the meantime Mr. Bainer will return to California for Christmas and consult with Dr. Reuther at Riverside and return to Spain on the 10th of January"and on and on. And about the time we were all through McMeekan stuck his head through the door. I guess he felt a little sheepish about just leaving me on my own. This was my first run-in with any of the Spaniards. McMeekan said, "How is everything going?" And said, "Everything is settled." McMeekan wouldn't believe it! And so, we turned everything over to the architect. This architect has two studios in Madrid. He's a doctor of architecture, whatever that means. He has eight architects and twenty-eight draftsmen working for him. They turned out a beautiful set of drawings, and I'm telling you they were beautiful. The elevations were all done in water colors. The Cordoba center (and that, of course, is where the Moors were in the south of Spain) was done in Moorish architectural style. But this fit in with other things around there. They found an old castle gate, which was incorporated into the plans as an entrance to the building. I tell you, it just was a magnificent set of drawings. He separated the administration wing connected onto one side. And in this administrative

Bainer: wing he had all of the administrative offices, auditorium, cafeteria, library, and extension offices. So all we have to do on the rest of the centers is to lift that section of the building and it fits any of the six centers because they all allow the same number of administrative people and other facilities.

And then in the other area he arranged the laboratories and offices the way I wanted them. There had to be a few little minor changes. Well we came to the final decision as to whether or not we were going to go for working drawings. You see all we had was preliminary drawings. The working drawings are something else. That's where you plan every room with all of the facilities and show everything. It will run probably a hundred pages of drawings. And so we had a meeting, and again, the old story -- all rooms are just too small. Everything is just too small. Well, I didn't say a word. I just decided, "They're paying for the thing. We'll make it as big as they want to make it." And so Tellez all of a sudden said, "Give me a sheet of paper and a pencil." He laid out a laboratory to his own dimensions, and allowed so much space for the side benches, so much for circulation space around benches, so much for the center benches, and added it all up and it came exactly to my dimensions for the laboratory. And he said, "Mr. Bainer, if we make this laboratory any bigger we'll have waste space in there." He came to his own conclusion. Nobody said anything. I had shown him this, you see, but he had to do it himself. Well, we turned the architect loose on the working drawings. And they were done the middle of May.

Dickman: This is for Cordoba?

Bainer: This is for Cordoba.

Dickman: And will you go through the same procedure?

Bainer: In the meantime I started working on preliminary sketches for El Encin, Valencia and La Coruna. While they were preparing working drawings for Cordoba, they started preliminary drawings for the other three stations. They were to have all these done in ten days. The others were much easier because he'd done one, you see. They're not going to be exactly alike, and the architecture style will be in fitting with the area. Well, something happened -- in administration it always happened. It happened in Brazil, and I'll get back to that in a minute. Dr. Tellez was demoted and a new president of INIA came into the picture. I'd never met him. This is the interesting thing. I was working for these people and yet I'd never met this man.

So, about the second weekend of February I guess it was, I was supposed to have these three preliminary sketches, and this

Bainer: architect had never let us down. He told us when he would deliver and was there. It came Friday night at five o'clock and these sketches weren't done. McMeekan came in and said, "Where are my drawings?" (He calls them his drawings.) "Well," I said, "I don't know. But our secretary said she saw the architect out here in the hall a couple of days ago and he hadn't come in and talked to us." "So," he said, "maybe he delivered them to the administrative offices." So McMeekan started looking for them in the Presidents office. I told our secretary, "Get ahold of the architect on the phone and find out if he's having trouble and what's the stage of these drawings." She got that architect on the phone and he said, "I haven't done anything on them. I'm working on the working drawings for the Cordoba but I haven't done anything on the sketches for the other three stations." And ten days had gone by! Well, what happened was, the new President had stopped the preparation of preliminary plans without even telling McMeekan. McMeekan saw the President in a hurry [Laughter]. They had a couple of rounds. I stayed out of it because this was something at the administrative level. I wasn't going to get mixed up in it. Let McMeekan handle this one.

I think what had happened was that the architect had never had a written contract with the Spanish government to do this work. He was doing it on the cuff and I think that he came in and wanted a written contract, which I don't blame him for. The new President was not familiar with what was going on, and he said, "I want to discuss this with you before we give you the contract," and he kept putting the architect off. And when Mr. McMeekan found out that this meddling was going on without informing us he blew his top. The architect assumed we'd been informed. See, he didn't come to me with anything.

Well, what happened was that McMeekan got the same treatment from this new guy that I got from Tellez. The President said to be there at six o'clock, and McMeekan was there at six o'clock to discuss this thing and at six o'clock he had some important visitor there. Finally the fellow came out and said, "Can you come back at seven?" Mr. McMeekan said, "Good day, if you want to see me I'll come back in the morning." He just walked out on him. He got a little rough with him. Of course, he was in a position where he could, he controlled the money. So at nine o'clock the next morning they had it out. They had the architect in and signed the contract. The President apologized. And McMeekan came over to my hotel to tell me that things were moving again, but we just lost ten days. And then the new President told Mr. McMeekan that there's not enough room in administrative offices. And so Mr. McMeekan very

Bainer: cleverly "Now, I'll tell you, Mr. President, we can extend this wing just as far as you want to go. We'll make it just as big as you want it. If it goes down a quarter of a mile that's all right, but remember, the bank is only going to pay for what's on this paper because we know this is adequate." And so this is some of the things that come up when you are dealing with a foreign government. They're all intelligent people but they're used to different things. Of course I had a chance with the staff at Cordoba, El Encin, and La Coruna, to discuss the size of the office and laboratories with those that were going to be using them. I got a hundred percent agreement on the size of the offices and laboratories. This is the thing that's kind of amazing now. I've had enough agreement that I've got confidence in the module that I selected. It was just out of the thin air, and everybody talks modules now. It's a funny thing, I knew they built buildings on a module basis but I never saw how easy it could be if you just selected the module and used it in multiples.

Dickman: You said you ran into this VIP thing in Brazil, too?

Bainer: Yes, the same thing happened down there. There was a change in administration in Brazil just as we finished the project. And this not being the new minister's project, you see -- the old administrator had this project. The new minister wasn't going to accept the report without doing some work so he could say it's his project. But Brazil never got as far as Spain is. Brazil was doing the study on the basis that they would make these changes, but at the time we knew they didn't have the money to do it. That was going to be a separate negotiation which fell through. They didn't get the money that they thought they were going to get. Spain went at this thing entirely different in that they had the money and now they're getting their plans. They're going to build these centers and other facilities needed like greenhouses, production structures, etc. The main thing is to get the big research centers up. Each one of them is going to be in the vicinity of 45,000 square feet. I found that building costs were very cheap in Spain.

Dickman: How much?

Bainer: About twelve dollars per square foot, and this includes air conditioning and heating. Well anyway, I'm more interested now, of course, in facilities for the research programs. I don't know just what my future duties are going to be. When I was hired, I was hired as a consultant and on the basis of approximately thirty days a year. I put in ninety days in

Bainer: the first six months. It paid off because we now have working drawings for one center and preliminary drawings for three others.

Dickman: What was the connection then with Brazil?

Bainer: IRI had the contract with AID in Brazil. IRI also has a contract with the Spanish government. Of course the World Bank is looking down over everybody's shoulder because they loaned this money at seven percent interest. So, it isn't a give away program. This is a hard cash deal. Provision is made to bring in six research coordinators who will act as co-directors of the centers. They'll have a native director who will work with the research coordinator, and they will jointly run this station. There's a provision to bring in fifty experts in various areas for shorter periods -- two weeks, two months, six months. These will be specialists in vegetable crops, citrus diseases, soils, etc. They have provisions to send out about a hundred people for further education over the five year period. Some will get master degrees, others will get doctor's degrees.

At the end of five years I would expect that Spain will have re-organized, re-activated, re-juvenated (whatever you want to call it) their whole agricultural research. And it's so much more -- so much larger in scope than I had ever dreamed. I hadn't really had enough advance information to know what I was running into. I had surmised that I would run into a situation like California which has the main research stations at Davis and Riverside. And then we have field stations at various locations. Spain is going to have main research stations at each of the six locations. In my opinion, this will be inefficient. Too much duplication. Eventually they hope to have a central computer in Madrid with remote operation at all the stations.

Dickman: Who thought of these sites?

Bainer: The Spanish selected the sites, but they had to be OKed by the committee from the World Bank. They're buying new land at La Coruna and Valencia for the centers.

Dickman: What's the state of the art -- agriculture -- mechanization?

Bainer; You find very advanced as well as primative mechanization. You see everything from oxen to tractors.

Dickman: What makes the difference?

Bainer: Size of operation, mainly. One of the things that's bothering me now is the size of citrus holdings. They run about two acres per farm in the Valencia area. It's pretty hard to standardize anything like root stalks or methods of handling when you have such small units. They're going to have to do a lot of work in citrus to become competitive with the other producers.

Dickman: How do their cattle compare with say, in Brazil?

Bainer: Oh, they're much more advanced in cattle in Spain. The trouble in Brazil was that it took five years to produce a marketable animal. In Spain, they're marketing the cattle too young. More veal is served in Spain than in any place I've ever been. To increase beef production all they'd have to do is hang onto the animals a little longer and put some fat on them. No, it's a different industry. They're bringing beef in from Argentina.

Faculty Club

Dickman: With your reputation as a fund raiser -- when they built the faculty club and they wanted a room for Professor Warren Tufts you had something to do with that, too.

Bainer: No, this wasn't the whole story. You see, they had to have furniture for the faculty club. So president C.C. Delwiche came to me and said, "You're well known here on the campus, having been here for so many years. We'd like to have you head up a small committee to raise money for furnishing the faculty club." He tried to get others but was turned down until he got Oscar Bacon over at entomology to act. I told him I didn't want to be the sole chairman of this committee, I would be a co-chairman because I had anticipated I was going to be away from here on consulting trips. I kept telling him that I shouldn't be in it at all. But, he wouldn't take no for an answer.

So, Oscar Bacon and I started to raise the money for furniture for the Faculty Club. You see they had money they had borrowed from the regents to build the clubhouse, but they had nothing in their budget for furniture. They figured they'd just have to raise it separately. So we started out with a letter to the faculty. Then money started dribbling in but it wasn't going to be enough. We figured we'd need fifty thousand

Bainer: dollars to do this job properly. I felt that if we could get twenty-five thousand within a year we could at least open the doors. You see we started on this before we opened the doors. This would give us enough money for the lounge, dining room and we were hoping for the kitchen.

It was very evident that these contributions were just nickel and dime affairs and we needed some more significant contributions. So Bacon and I went before the board, and proposed that possibly if they would name some rooms after important people that had been on this campus or were on the campus, that it would be easier to pick up the money if it was going to honor somebody, you see. And so I said, "Here's Dr. Tufts who was around here for forty-five years and nothing around here's been named for him." I felt awfully bad about it. And so I went to his widow, and I said, "I have in mind a little project in honor of Warren," and she thought it was a great idea and in fact, assured me of her financial support.

So I started on some of Warren's old cronies -- a lot of them are retired like Veihmeyer, Knott, Storer, Wilson, Madson, etc., and others. The checks that I got from these people were running about two and a half or three times what I was getting from the other members.

The first thing you knew, we had about $5000 which was enough to furnish the living room in honor of Warren Tufts. I mentioned this at the first annual meeting of the club. You see -- here was a trial balloon that we threw out that we would try to name these rooms. We got permission from the board to do it.

Two other groups came to me, one from agronomy -- Merton Love, for example, came to me and said, "Well, if you're doing that for Tufts, why aren't we doing something for Ben Madson?" Well I said, "I'm just waiting for you guys to do something. After all we'd had some success on this thing, somebody else has to do something."

So Merton Love said "I'll give a hundred dollars and it's going to be earmarked for a room for Ben Madson. Unfortunately I'm going to leave for Europe in two weeks, maybe we can get things rolling before I go." He was really sincere about this thing. He left and I guess he left it in the hands of some others. The boy who really went all out was Milton Miller, an extension man in agronomy and a great friend of Madson. He wrote letters to Ben's friends all over the state. The interesting thing is they set up their own committee up as a

Bainer: subcommittee of ours. I certainly left them alone. All we wanted was the money. I didn't care how he got it. By golly, after they had sent the letter out, they thought maybe they ought to say something to Ben about it. Ben said, "Nothing doing. I'm not going to be involved here. You guys just pull in your horns." [Laughter] Well, this was an embarrassing situation. They already had money coming in, you see. Poor Milton Miller. I felt so sorry for him. And so Milt called me up and said, "I guess we're just going to have to return the money to all of those people." I said, "To heck with you. Let me handle this,"so I went over to Ben's house without even calling him up. I sat down and talked to him for about a half hour and said, "Ben, you ought to be proud of these people. Why, you've got friends all over the state, and you mean to say you don't want them to continue being your friend," you know, and so forth and so forth. [Laughter] I said, "The university gave you an honorary degree and they didn't ask you whether you'd accept it." He said, "They said I'd have to be there to accept it." And I said, "You were there, weren't you?" We just kidded along and finally Ben said, "Well, tell them to go ahead." [Laughter] That's why the game-room was named for Ben Madson. Actually they got their money faster and it looked for a while like they were going to outdo the Tufts fund.

Well then there was a group that wanted to name the library for Dr. Hart. Ray Bankowski came to me about the same time that Love did and said, "I think we've missed the boat in not doing something for Dr. Hart." I've tried to motivate those people but things happened. I still think they could do a lot toward raising funds for the library and reading room. But that's the way these things go.

HOBBIES AND CIVIC ACTIVITIES

Dickman: We haven't talked about your hobbies. This wasn't really a hobby, but back in the World War II years you worked on the railroad.

Bainer: Well, this was a rather interesting experience and I suppose it was a feeling of patriotism that prompted me to do this. We had an agent here at the Southern Pacific by the name of Sam Brinley, and he was quite a man about town. He knew everybody in town, and he apparently made some bragging remark. See, the railroad was experiencing difficulty in not having enough labor to do some of the track work and to unload freight in Oakland. Sam said, "I can have forty people on that job every Sunday." And they called his bluff. So Sam started in working on the people at Davis to help out. We were taken by train to Fairfield and then rode a handcar up the branch that runs over to Mare Island. That little old branch never had much traffic until the war. There were eight freights a day through there, and the track was just going to pieces. They were afraid of having derailments and so forth. They had regular crews working in there during the week but they figured if they could bring another 40, 50, 75 or 100 to tamp ties and ballast that line it would help. I learned quite a bit of the tricks of tamping ballast under ties. It's hard work, but we accomplished a considerable amount in helping rebuild that line between Fairfield and Vallejo. We didn't get all the way over but we certainly worked over several miles.

Well, when this experiment was working out so well, they decided to take us to Oakland to help unload freight that was piling up. We were only making around ten dollars a day but it was a feeling that we were contributing something like my wife working in the cannery on the swing shift with a lot of Davis women just because it was the thing to do. It was some contribution toward the war effort.

Old Sam really knew how to run a railroad. There wasn't any question about it. He had an extra car attached to the Overland Limited and stopped it at Davis. We were in Oakland before eight o'clock in the morning, and we came back on the seven-forty-seven in the evening.

Dickman: And how many of you were there?

Bainer: A maximum maybe of eighty.

Dickman: And how long did you do this?

Bainer: Oh, we did this every week, week after week.

Dickman: And for how long?

Bainer: I don't know. It went on for several months. And Sam got quite a reputation, you see, for recruiting labor. So the SP magazine had an article and picture about Sam Brinley and his latest recruits from Davis. This was posed southwest of the depot. That picture in the paper the other day showed Del Marshall, who was the superintendent of public schools, Jim Wilson who was in animal husbandry, Jim Burke who was a bookkeeper in town and myself.

Dickman: Did this thing catch on throughout the country?

Bainer: Yes, I think it did. I think there was quite a bit of it. But Sam was the leader. He figured he could do it and he had enough friends to make it go. It reminds me somewhat of Blackwelder's experience during the war when he was short of labor down at Rio Vista. He put out a call, and the people from the banks, schools, post office, and stores came down and put in four or five hours in the early part of the evening to help assemble sugar beet harvesters. He said he couldn't have done it without their help.

Dickman: You played piano in the Rotary Club, didn't you? Did you play by ear?

Bainer: No, I never could play by ear. I have to have music in front of me. The Rotary Club at Davis had Mrs. Reagan as their pianist, and this kind of cramped their style to have a woman coming in all the time. So Bill Robbins came to me and said, "We want you to join the Rotary Club and be our pianist." I had no interest in Rotary. I didn't know what it was. I was just a young fellow here, and I said, "Furthermore I have a lab every Monday afternoon and I couldn't even stay for the meeting." Well, they'd make arrangements for me to leave early and finally persuaded me to come. Well, I played for Rotary for quite a while, and then we took another pianist in and I just bowed out. I still substitute down there.

I think the real significant thing that happened though was about the time I was going to start this engineering college. I felt the need for some relaxation or something that would give me a complete change. My wife and I had been attending some meetings here in town of an organ group. A fellow from

Bainer: the organ company in Sacramento came over. This guy, I noticed, did a very good job of playing and all he needed was just the melody line with the chords indicated -- D minor or D major, F-seventh or whatever it might be. He could add a handfull of notes and make it sound good. I said, "Golly this is the kind of playing I've always wanted to do. Would you fool around with a guy like me if I wanted to take lessons?" He said, "Well, this is my business." And I said, "Would you give them in the evenings?" And he said, "Oh yes, I give lots of lessons in the evenings." I said, "Would you just give two lessons a month? I don't have time to practice." [Laughter] And this was before I had an organ. I was still playing the piano. So I went over and I took lessons for about four months -- that was eight lessons. I know that guy figured I wasted my time, but I got the basics from him and from that time on I was able to work out the technique.

Then on my Christmas list every year (our family always makes a list of what they'd like to have) I always listed I'd like to have an organ. Well, I never thought anybody would ever buy one. I went to Chicago to the ASAE meeting and got back just before Christmas. When I came into the house here was an organ sitting in the living room. I said to my wife, "You didn't buy an organ?" She said, "No, I just rented it for a month to let you play around with it for a month." That was it. I never let it get out. And you know the lessons I'd taken on this chord playing made the organ sound pretty good. You play the melody with one finger and throw the accompanying chords with the left hand. Of course, you've got to learn to play all the bass with your feet. This was just what I needed at the time we started this engineering college. Boy, when I'd go home all tied up in knots, all I had to do was sit down at the organ for a half hour or forty-five minutes and unravel.

Another hobby is golf. My next door neighbor, Dr. Tufts, persuaded me to join the El Macero golf club. I took a few lessons but I'll never be a golfer. I enjoy the game and play regularly now and with a bunch of fellows that play about as badly as I do. And yesterday we were out there and Leach had 102, Herman Spieth had 102, Jim Guyman had 106 and I had 106. [Laughter] You see, there we were, all equally bad. I've been down to 91. But, we have a great time.

Dickman: While we're still on things that are avocations, you're a member of the Davis Food and Wine Society?

Bainer: Yes.

Dickman: What does that involve?

Bainer: It was originally set up by the people in enology. They felt that they would like to have a dinner occasionally in which they could complement it with different wines. They were going to hotels and have them provide the dinner and then they would pick their own wines and make an evening out of it. I was invited at the time they held the meeting at the Hotel Woodland. The dinner was lousy but they had some good wines. I suppose the dinner tasted better than it would have without the wines. I said, "My gosh, for the amount of money we spent for this dinner I could put on a better dinner in my backyard." Being a new member I don't know why I stuck my neck out but somebody overheard it because when we got ready for the next meeting, the chairman came to me and said, "Were you really sincere about putting on one of these dinners in your backyard?" That's when I lived out in Solano County. I said, "Why sure, there wouldn't be any problem." There would only be twenty guys there, or twenty-five at the most.

So we set up out in the backyard and the committee divided up the cooking to be done. I was to have a committee for the meat and we were going to charcoal broil some steaks this particular time. I remember Dr. Hart was a member, and he was on my committee. I had marinated this meat and it was lovely meat, it really was, and it came out just beautifully. I didn't have enough grills to do the whole job in the backyard but I had two grills in my electric stove and I could start these darn steaks. While they were finishing up we'd bring them out and finish them up on the charcoal grill. This was the beginning of having this deal in our homes. So we meet about three times a year in different homes. I've had them at my home a couple or three times. I've got lots of room. The whole dinner is planned by a committee, and the responsibility for preparing the soup, salad, entree (usually the entree the chairman is responsible), desserts, and the coffee is delegated to sub-committees of two. And boy, some of these fellows really have a great imagination and they send the recipes for what you're going to prepare. For example, last fall I was on the committee to prepare a bean sprout salad. I looked at that recipe and it just didn't look good to me, but I did it exactly according to the recipe, and it was one of the greatest salads you ever had. I never tasted anything or smelled anything as good as that. My wife sent that recipe to her sister and she has been serving that salad back in Kansas. When I was in Spain, my wife made

Bainer: a bean sprout salad for herself three times, she said. Well anyway, we learned how to make different things. It's a very delightful experience and we're limited to about thirty members.

Dickman: When did you join the Chamber of Commerce?

Bainer: Well, I was a member of the Chamber of Commerce back in war time. Professor Walker was president of the Chamber of Commerce from '45 to '47, and his great accomplishment was the annexation of College Park. They really needed to come because everybody had a septic tank and during a real wet winter they had water in their basements. They needed to be hooked onto the city sewer. I don't think anybody's regretted they came in the city. That was the beginning of the expansion of Davis.

Then I was elected to follow Walker as president in 1947. And, I accepted it even though I hadn't been too active in civic affairs.

The thing that came up in my regime was the Sacramento Port. It was a red hot issue because they were trying to set up a port district involving all of Yolo County which meant that Davis would be in this port district. The board decided that Davis had no business being in this port district. So we began a campaign to keep Davis out. Boy if you don't think there were pros and cons on this issue, you are wrong. Even the Sacramento Chamber of Commerce board invited us to a luncheon, and tried to persuade us that we were wrong. We were not persuaded. When it came to a vote, the only part of Yolo County that remained in the port district was West Sacramento. Woodland and Winters pulled. And Davis, of course, never came in. Some of the people that had been the most critical of us at that time came back three or four years later and patted us on the back for staying out.

Dickman: Did you get involved in the Hunt-Wesson controversy?

Bainer: That was after my time thank goodness; that was another battle around here but it was resolved and everything's come out all right.

HONORS AND AWARDS

Dickman: It must have been a real thrill since your father was a charter member of the ASAE to have been selected for the McCormick medal by ASAE.

Bainer: Of course it certainly was a surprise. This medal had been given since 1931 and I received it in 1948. So you can see there were quite a few medalists in the society before I was fortunate enough to be a recipient. And when you looked at the people that had received medals they were all very outstanding men. Of course, one wonders whether or not he can ever measure up to the people that had already received one. It came as a great surprise and I certainly felt honored.

Of course being a member of ASAE and being very close to many of the people who had received it, I wouldn't say that I never expected to get it. It didn't come as much of a surprise as some of the other honors that I received later. For example in 1960 I received an honor from my alma mater which surprised me to a great extent. But when I got word from the University of Missouri two years later that they wanted to give me the same honor that I'd received at Kansas State which was an achievement award I was really surprised because I'd never had any real contact at the University of Missouri except in the field of agricultural engineering. I found that the ag engineers were the ones that had nominated me for this award. And when I looked at the list of people outside of University of Missouri graduates that had received it, most of them were ag engineers which surprised me.

That same year, 1962, I was just flabbergasted when I received a letter from the secretary of the American Society of Engineering Education stating that I was to receive the Vincent Bendix award. It was given to members of the society who had achieved a certain distinction in research. This was awarded at the annual meeting of the society which was held at the Air Force Academy at Colorado Springs, and was a very delightful experience.

But the greatest surprise of all was in 1965 when I received notification that I'd been elected to the National Academy of Engineering, and this was a real shocker because the academy had only been organized with twenty-five founding members. Many of them were members of the National Academy of Science. I found that these twenty-five founding members decided they were going to propose men from all branches of engineering for

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA

IN RECOGNITION OF HIS MERITORIOUS ACHIEVEMENTS HAVE CONFERRED
THE DEGREE OF DOCTOR OF LAWS UPON

ROY BAINER

BELOVED FRIEND OF STUDENT AND FACULTY, INSPIRING TEACHER, BRILLIANT RESEARCHER, ABLE ADMINISTRATOR, YOUR OUTSTANDING ACCOMPLISHMENTS IN THE MANY FACETS OF ACADEMIC LIFE ARE AN INSPIRATION TO US ALL; FAITHFUL SERVANT OF YOUR UNIVERSITY AND YOUR COUNTRY, WORLD LEADER IN MECHANIZED AGRICULTURE, YOUR EXPERT COUNSEL HAS BEEN WIDELY SOUGHT AND GENEROUSLY GIVEN AT HOME AND ABROAD; STAUNCH AND LOYAL SUPPORTER OF THE ENGINEERING PROFESSION, YOU HAVE BEEN SHOWERED WITH HONORS IN RECOGNITION OF YOUR DEVOTED SERVICE TO ITS LEARNED SOCIETIES · YOUR BOUNDLESS ENTHUSIASM AND GENIAL DISPOSITION HAVE ENDEARED YOU TO US, YOUR COLLEAGUES, FOR FOUR DECADES
WE SALUTE YOU TODAY IN MEMORY OF THOSE HAPPY YEARS

IN WITNESS WHEREOF THIS DIPLOMA IS INSCRIBED WITH THE SIGNATURES OF THE PRESIDENT OF THE REGENTS AND THE PRESIDENT OF THE UNIVERSITY, AND TO IT HAS BEEN AFFIXED THE OFFICIAL SEAL

GIVEN AT DAVIS THIS FOURTEENTH DAY OF JUNE IN THE YEAR OF
OUR LORD ONE THOUSAND NINE HUNDRED AND SIXTY-NINE
AND OF THIS UNIVERSITY THE ONE HUNDRED AND SECOND

Ronald Reagan
GOVERNOR OF CALIFORNIA AND
PRESIDENT OF THE REGENTS

PRESIDENT OF THE UNIVERSITY

Bainer: membership. I was brought in from agricultural engineering. Certainly had I been in another branch of engineering, I wouldn't have been elected. They delegated me, as a sub committee, to look for an ag engineer that worked in the livestock area. So I had that privilege of proposing Clarence Kelly and he was elected. He was doing the animal environmental work. Well this was kind of embarrassing because he also was from Davis. However, he filled the position that they wanted to fill. They also wanted me to find an engineer working in fisheries. I found Milo Bell at the University of Washington that was in engineering that has related to fisheries. He had done some very significant work. They then wanted me to find somebody in forestry, a good outstanding engineer that was working in the forestry area. And do you know, to this day we haven't found one. And I really looked all over the country, but just didn't find one that we thought was qualified. This is the seventh election this year, and when you look at the records of the people that are proposed, you wonder how in the world they ever dipped down low enough in the barrel to pick you out.

Additional Awards

Bainer: During the two weeks period prior to my retirement I received three most cherished honors. The first came during commencement when the university awarded me an honorary doctor of laws degree (LLD). The second was an Outstanding Civilian Service medal from the Department of the Army. And the third came in a letter from President Hitch dated the 30th of June, 1969, stating that the regents had named the new engineering building Roy Bainer Hall.

An interesting sidelight on the honorary degree was related to me by Jack Oswald, who was then vice president of the university. According to Jack, the General Council informed the regents, after they had voted the degree, that they were in violation of their standing orders. They specifically stated an honorary degree to a faculty member could not be given until the member was fully retired. (Provosts and chancellors were excepted.) In my case that would be two weeks after commencement. At the next meeting of the regents, they set aside their standing order long enough to grant the degree. Now I understand that the standing orders have been changed so that an honorary degree cannot be awarded to a faculty member before eleven months after retirement.

Dickman: This concludes what to me is a very interesting memoir and, as the interviewer, an experience I cherish.

APPENDIX

BIOGRAPHICAL OUTLINE OF ROY BAINER

Father: Harry M. Bainer was a charter member of ASAE

Mother: Clara Ellen (Nitcher) Bainer

1902 Roy Bainer born near Ottawa, Kansas

1914-1918
Attended high schools in Amarillo, Texas, and Topeka, Kansas

1914-1917
Worked during the summers on USDA Cereal Experiment Station at Amarillo, Texas

1918-1924
Operated a wheat farm near Scott City, Kansas

1919-1920
Worked winters on the assembly and test floor of Charter Gas Engine Company, Sterling, Illinois, and Venn-Severin Engine Company, Chicago, Illinois

1921-1923
Served as field service man (on call during summers), Twin City Tractor Company, Scott City, Kansas

1921-1922
Attended School of Agriculture, Kansas State University

1926 Married Lena M. Cook

1926 Received B.S. degree in Agricultural Engineering, Kansas State University

1926-1927
Instructor-Junior Agricultural Engineer, Kansas State University

1927-1929
Assistant Professor-Assistant Agricultural Engineer, Kansas State University

1929 Received M.S. degree in Agricultural Engineering, Kansas State University

1929-1937
Assistant Professor-Assistant Agricultural Engineer, University of California, Davis

1934 Daughter La Nelle Bainer born

1937-1943
Associate Professor-Associate Agricultural Engineer, University of California, Davis

1943-1969
Professor-Agricultural Engineer, University of California, Davis

1947-1961
Chairman, Department of Agricultural Engineering, University of California, Davis

1952-1961
Assistant Dean of Engineering, Statewide, University of California

1961-1962
Associate Dean of Engineering, Statewide, University of California

1962-1969
Dean of Engineering, University of California, Davis

1945 British Ministry of Agriculture on the mechanization of sugar beet production (three months)

1948 U.S. Army of Occupation in Japan on a study of agricultural mechanization (three months)

1958 Food and Agriculture Organization (FAO) of the United Nations in Chillan, Chile. Co-director of a mechanization center for representatives from eight South American countries (six weeks)

1961-1969
A total of eleven visits to Peru for FAO in connection with the development of a five-year professional program in agricultural engineering at the Agrarian University of Peru at La Molina (total time approximately six months)

1961-1964
Committee on Agricultural Science (advisory to Secretary of Agriculture Freeman--total time three months)

1962 Contacted Fidel Castro in Cuba for the Tractors for Freedom Committee in regard to the exchange of tractors for 1,214 prisoners taken in the Bay of Pigs fiasco (four days)

1966 Kasetsart University, Bangkok, Thailand, on the planning of a complete college of engineering (three weeks)

1966 AID, U.S. State Department in Laos, to study the possibility of increasing rice production (one month)

1967-1969
Central American Research Institute for Industry in Guatemala, serving five Central American countries (total time three weeks)

1969 IRI Research Institute, advising the Brazilian Ministry of Agriculture on the reorganization of the agricultural experiment stations in the states of Parana and Sao Paulo (three months)

1971-1972
IRI Research Institute, planning six commodity-oriented research centers in Spain (three months)

CLUB AND ASSOCIATION MEMBERSHIPS OF ROY BAINER

Life Fellow, American Society of Agricultural Engineers
past chairman of college division
past chairman of power and machinery division
past chairman of Pacific coast section
president 1956-1957

Member, National Research Council 1961-1969

Life Member, American Society of Engineering Education

Fellow, American Society for the Advancement of Science

Member, Tau Beta Pi

Member, Gamma Sigma Delta

Member, Phi Mu Alpha

Member, Sigma Xi

Member, Sigma Alpha Epsilon

Member, Commonwealth Club of San Francisco

Member, Faculty Clubs, UC Davis and UC Berkeley
past president of UC Davis Faculty Club

Member, Presbyterian Community Church

Member, Republican Party

Member, Rotary Club
past president of Davis Rotary Club

Member, Davis Chamber of Commerce
past president

Member, University of California Patent Board 1960-1969

Member, Agricultural Board of National Academy of Science 1957-1961

Committeeman, Policy Committee on the University of California/
University of Chile exchange program sponsored by the
Ford Foundation 1964-1969

Official United States delegate, to International Rice Year, England and Italy 1966

Member, Engineering Advisory Council, Kansas State University 1969-1972

Member, Engineering Advisory Council, University of California, Statewide, 1971--

HONORS OF ROY BAINER

1948	McCormick Medal, American Society of Agricultural Engineering
1954	Distinguished Service Award, American Society of Sugar Beet Technologists
1960	Distinguished Service Award, Kansas State University
1962	Distinguished Service Award, University of Missouri
1962	Vincent Bendix Medal, American Society of Engineering Education
1964	Honorary Professorship, Agrarian University of Peru
1965	Election to National Academy of Engineering
1969	Honorary Doctor of Laws Degree, University of California
1969	New engineering building named Roy Bainer Hall, University of California, Davis

BIBLIOGRAPHY OF ROY BAINER

Call, L. E., Aicher, L. C., McCampbell, C. W., and Bainer, R. "Beef Cattle Investigations 1928-29." Seventeenth Annual Cattlemen's Round-up. Kansas Agricultural Experiment Station 11 pp. (April 1929)

Bainer, R., and Hinrichs, H. S. "Wiring the Farmstead." Kansas State Extension Service Bulletin, no. 63. 20 pp. (May 1929)

Bainer, R., and Jorgenson, L. M. "Electrical Cooking in the Farm Home." Kansas State Extension Service Bulletin, no. 66. 16 pp. (May 1930)

Bainer, Roy. "A Temperature Study of Dairy Barn Floors." Agricultural Engineering 11(5):187-190 (May 1930)

Bainer, Roy. "A Machine for Distributing Sulphate of Ammonia in the Fertilization of Rice." Agricultural Engineering 11(7):239-240 (July 1930)

Bainer, R., and Long, D. J. "Equipment for the Bulk Handling of Grain." California Agricultural Extension Service Circular, no. 47. 25 pp. (October 1930)

Bainer, Roy. "The Row Crop Tractor in California." Implement Record, Tractor and Farm Equipment 28(1):41 (January 1931)

Bainer, Roy. "Preliminary Trials of a New Type Mower." Agricultural Engineering 12(5):165-166 (May 1931)

Bainer, R., and Frost, K. R. "Tests on Hose for Fighting Rural Fires." Agricultural Engineering 12(5):171-172 (May 1931)

Bainer, Roy. "Tests of 1 and 1-1/2 Inch Fire Hose." National Fire Protection Association Quarterly 25(3):284-287 (January 1932)

Bainer, Roy. "Result of Tests of a Crusher-Type Mower." Implement Record, Tractor and Farm Equipment 29(1):32 (January 1932)

Bainer, Roy. "Artificial Drying of Hay." Implement Record, Tractor and Farm Equipment 29(2):22-23 (February 1932)

Bainer, Roy. "Harvesting and Drying Rough Rice in California." UC Agricultural Experiment Station Bulletin, no. 541. 29 pp. (September 1932)

Bainer, R., Torpen, E. A., and Fairbank, J. P. "Attachments for Mowers to Cut Vetch." UC Agricultural Extension Service Information Series, no. 6. 10 pp. (May 1934)

Bainer, R., Torpen, E. A., and Fairbank, J. P. "Mower Attachments to Cut Vetch." Implement Record, Tractor and Farm Equipment 31(7):5-7 (July 1934)

Bainer, R., and Borthwick, H. A. "Thresher and Other Mechanical Injury to Seed Beans of the Lima Type." UC Agricultural Experiment Station Bulletin, no. 580. 30 pp. (July 1934)

Fairbank, J. P., and Bainer, R. "Spark Arresters for Motorized Equipment." UC Agricultural Experiment Station Bulletin, no. 577. 42 pp. (July 1934)

Bainer, Roy. "Stationary Spray Plants on the Increase." Pacific Rural Press, no. 8. p. 192 (February 1935)

Bainer, R., and French. O. C. "Stationary Spray Plant Tests." Pacific Rural Press, no. 9. p. 467 (November 1935)

Bainer, R., and French, O. C. "Stationary Spray Plant Study." The Blue Anchor 12(1):2-4, 18 (January 1936)

Bainer, Roy. "Rice Harvesting and Drying Machinery." Pacific Rural Press. p. 767 (June 1936)

Bainer, Roy. "Developments in Seed Bean Threshing." Pacific Rural Press, no. 8. pp. 242-243 (February 1937)

Bainer, R., and Winters, J. S. "New Principles in Threshing Lima Bean Seed." Agricultural Engineering 18(5):205-206 (May 1937)

Bainer, R., and Winters, J. S. "A Flax Seed Plot Thresher." Agricultural Engineering 18(8):363-364 (August 1937)

Bainer, R., and Winters, J. S. "Results of Tests of a Rubber Roller Seed Bean Thresher." Agricultural Engineering 19(6)251-252 (June 1938)

Bainer, R., and Barbee, C. E. "An Internal-Combustion Nut Cracker." Agricultural Engineering 20(1):21-22 (January 1939)

Bainer, Roy. "Progress in Sugar Beet Machinery Development." Spreckels Sugar Beet Bulletin 4(1):1-4 (January 1940)

Bainer, Roy. "Progress in Development of Sugar Beet Machinery." Through the Leaves 28(1):10-12 (January 1940)

Bainer, Roy. "Sugar Beet Harvester Tests 1938-1939." Proceedings of the American Society of Sugar Beet Technologists 1940 (Part II). pp. 274-282 (1942)

Bainer, Roy. "Sheared Sugar Beet Seed Investigations." Spreckels Sugar Beet Bulletin 6(1):1-2 (January 1942)

Bainer, Roy. "Beet Seed Shearer." Implement Record, Tractor and Farm Equipment 39(4):13-18 (April 1942)

Bainer, Roy. "Sheared Sugar Beet Seed Investigations." The National Beet Grower 10(9):1, 5 (May 1942)

Bainer, Roy. "Use of Sheared Beet Seed on the Increase." Spreckels Sugar Beet Bulletin 6(11):65-68 (November 1942)

Bainer, Roy. "Use of Sheared Seed on Increase." Through the Leaves 31(1):6-9 (January-February 1943)

Bainer, Roy. "Sheared Seed--Dixie Beet Thinner." New Agriculture (May 1943)

Bainer, Roy. "New Developments in Sugar Beet Production." Agricultural Engineering 24(8):255-258 (August 1943)

Leach, L. D., and Bainer, R. "Seed Treatment of Segmented Seed." Proceedings of the American Society of Sugar Beet Technologists 1942. pp. 220-227 (1944)

Bainer, Roy. "Seed Segmenting Devices." Proceedings of the American Society of Sugar Beet Technologists 1942. pp. 216-219 (1944)

Bainer, Roy. "Harvesting and Drying Rough Rice in California." Rice Journal 47(7):12, 14 (July 1944)

Bainer, Roy. "Planter Development for Segmented Sugar Beet Seed." Proceedings of the American Society of Sugar Beet Technologists. pp. 53-59C (February 1944)

Bainer, R., and Leach, L. D. "Processing Sugar Beet Seed by Decortication, Burr Reduction and Segmentation" Proceedings, Fourth General Meeting 1946, American Society of Sugar Beet Technologists. pp. 625-639 (1946)

Leach, L. D., Bainer, R., and Doneen, L. D. "Emergence and Rate of Emergence of Sugar Beet Seed as Influenced by Seed Preparation, Soil Moisture and Temperature." Proceedings, Fourth General Meeting 1946, American Society of Sugar Beet Technologists. pp. 106-116 (1946)

Bainer, Roy. "Sugar Beet Harvesting in the U.S.A." Agricultural Engineering Record. pp. 106-110 (Summer 1946)

Bainer, Roy. "Mechanized Sugar Beet Production." California Beet Growers Association Bulletin. pp. 13, 29 (1947)

Bainer, Roy. "Precision Planting Equipment." Agricultural Engineering 28(2):49-54 (February 1947)

Bainer, Roy. "Engineering in Crop Production." California Citrograph 32(4):140, 150-152 (February 1947)

Bainer, Roy. "A Short Résumé of the Present Status of the Beet Processing Program." Sugar Journal 9(10):14-15 (March 1947)

Bainer, Roy. "Precision Planter for Row Crop Seeds Proved Successful." California Agriculture 1(6):1, 3 (May 1947)

Bainer, Roy. "The Development of Precision Planting Equipment." Spreckels Sugar Beet Bulletin 11(3):19-23 (May-June 1947)

Bainer, Roy. "Precision Planters for Row Crops." Western Grower and Shipper 13(9):14, 33 (August 1947)

Robbins, W. W., and Bainer, R. "Pre-emergence Spray for Weed Control in Sugar Beets Seeded in Undisturbed Soil Successful." California Agriculture 1(11):1-2 (October 1947)

Robbins, W. W., and Bainer, R. "Pre-emergence Spray for Weed Control in Sugar Beets Seeded in Undisturbed Soil Successful." New Agriculture 30(2):8-9 (November 1947)

Bainer, Roy. "The Processing of Sugar Beet Seed." Agricultural Engineering 29(11):477-479 (November 1948)

Bainer, Roy. "Present Status of Sugar Beet Seed Processing." Paper presented and published in bound volume of American Society of Sugar Beet Technologists, Proceedings of Fifth General Meeting (1948)

Bainer, Roy. "Mechanized Agriculture." California Agriculture 4(1):4, 10, 14 (January 1950)

Jones, L. G., Bainer, R., Kepner, R. A., and Fairbank, J. P. "Alfalfa Seed Harvesting." California Agriculture 4(8):8, 9, 16 (August 1950)

Bainer, Roy. "Problems and Engineering Data of Interest to the Power Farmer." Power Farming in Australia and New Zealand 59(7):47, 51 (July 1950)

Bainer, Roy. "New Concepts in Side-Delivery Rakes." Agricultural Engineering 32(5):266-268 (May 1951)

Bainer, Roy. "Novel Side-Delivery Rakes." Implement Record, Tractor and Farm Equipment pp. 17-20, 80 (June 1951)

Bainer, Roy. "Twenty-One Years." The California Citrograph 37(6):234, 252 (April 1952)

Bainer, R., Barger, E. L., Carleton, W. M., and McKibben, E. G. "Tractors and Their Power Units." John Wiley & Sons, New York. 496 pp. (1952)

Bainer, Roy. "Classrooms on the Farm." California Monthly 62(10): 18-19, 50-52 (June-July 1952)

Bainer, Roy. "How Can We Hire, Train and Hold More, Better Men?" Implement Record, Tractor and Farm Equipment 50(7): 20, 54 (June 1953)

Bainer, Roy, Kepner, R. A., and Barger, E. L. "Engineering Elements of Farm Machinery." Lithoprint Edition. 312 pp. (September 1953)

Bainer, Roy. "Technology in Agriculture." California Monthly 54(10):15-17 (June-July 1954)

Bainer, Roy. "Designs for Tomorrow." Western Farm Equipment 58(8): 25-27 (July 1954)

Bainer, Roy. "A Review of Agricultural Engineering Activities." Presented to the Farm Machinery Conference (February 1955)

Goss, J. R., Curley, R. G., Bainer, R., and Smeltzer, D. G. "First Year Results of Corn Harvesting Studies." Presented to the Farm Machinery Conference (February 1955)

Bainer, Roy. "College-Industry Cooperative Research." Agricultural Engineering 36(6):385-388 (June 1955)

Bainer, R., Goss, J. R., Curley, R. G., and Smeltzer, D. G. "Combine Used in Corn." California Agriculture 9(7):12, 13 (July 1955)

Bainer, R., Kepner, R. A., and Barger, E. L. "Principles of Farm Machinery." John Wiley and Sons, New York. 571 pp. (October 1955)

Goss, J. R., Bainer, R., and Curley, R. G. "Field Tests of Combines in Corn." Agricultural Engineering 36(12):794-796 (December 1955)

Bainer, Roy. "The Challenge of Soil Compaction." Presented at Farm Machinery Conference (January 1957)

Bainer, Roy. "Agricultural Engineering Activities." Presented at Agricultural Extension Service Conference (January 1957)

Bainer, Roy. "Mechanical Horses--The Crops They Bring and the Men Who Guide Them." Proceedings of seminar, Thor Research Center. pp. 4-12 (October 1956)

Bainer, Roy. "The Need for Research in Seed Processing." Proceedings of Seed Processors Conference. pp. 41-42 (February 1957)

Bainer, Roy. "The Engineer's Place in Agriculture." Agricultural Engineering 38(6):377, 387 (June 1957)

Bainer, Roy. "The Golden Anniversary of Agricultural Engineering." Agricultural Engineering 38(7):513, 544 (July 1957)

Bainer, Roy. "University Round Table of Western Farmers' Needs--California." Western Farm Equipment (National Souvenir Ed.) pp. 103-105 (October 1957)

Bainer, Roy. "Mechanization and Application Methods." Proceedings of Tenth Annual California Weed Conference. pp. 72-76 (January 1958)

Bainer, Roy. "Challenge of Soil Compaction." California Farmer p. 456 (April 1958)

Bainer, Roy. "Research and Development in California Agriculture." Western Farm Equipment 56(4):18-20 (May 1959)

Bainer, Roy. "Agricultural Engineering Activities Related to Livestock Production." Mimeograph 5pp. (1959)

Bainer, Roy. "Needed Research in Farm Electrification." Mimeograph 5pp. (1959)

Bainer, R., Barre, H. J., Schwab, G. O., Turnbull, J., and Reynolds, B. C. Report of Comprehensive Review of Agricultural Engineering Research, New York (Cornell). Mimeograph 18pp. (October 1959)

Bainer, R., Reynolds, B. C., Turnbull, J., and Wood, I. D. Comprehensive Review of Agricultural Engineering Research, Colorado Agricultural Experiment Station. Mimeograph 13 pp. (December 1959)

Bainer, R., Barre, H. J., Hienton, T. E., Turnbull, J., and Reynolds, B. C. Comprehensive Review of Agricultural Engineering Research. Washington Agricultural Experimental Station. Mimeograph 26 pp. (January 1960)

Bainer, Roy. "Some New Agricultural Equipment Developments." Mimeograph 4 pp. (1960)

Bainer, Roy. "Engineering in Agriculture." The American Farm Youth. 3 pp. (April 1960)

Bainer, Roy. "Needed Research in Farm Electrification." Farm Electrification 14(3):13-15 (May-June 1960)

Bainer, Roy. "Engineering Implications in Producing Agricultural Crops." Proceedings, Ninth Annual Meeting of the Agricultural Research Institute, National Academy of Sciences, National Research Council (October 1960)

Bainer, Roy. "Mechanization--Key to California's Vast Agricultural Growth." Central News 14(6):1, 5 (November 1960)

Bainer, Roy. "Some Engineering Problems in Metering Fertilizers." Proceedings, Tenth Annual Fertilizer Conference. pp. 7-9 (1962)

Bainer, Roy. "The Land-Grant College Act and Technology." University of Missouri Honor Award Bulletin. pp. 20-24 (1962)

Bainer, Roy. "Progressi Nella Meccanizzazione Delle Operazioni de Raccolta in Ortofrutticoltura--Macchine e Notori Agricoli." Volzohol. pp. 36-40 (January 1962)

Bainer, Roy. "Mechanized Crop Production." Voice of America, Series 16. pp. 1-10 (August 1964)

Bainer, Roy. "Bio-Engineering Problems as Related to Agricultural Engineering." Presented at Annual Meeting of American Society for Engineering Education. Paper No. 155.1 (June 1963)

Bainer, Roy. "Report on NAS Engineering and Industrial Research." Journal of the American Society of Agricultural Engineers 46(4): 203 (April 1965)

Bainer, Roy. "The Development of an Agricultural Engineering Program in Latin America." Presented at Annual Meeting, American Society for Engineering Education. Paper No. 204.1-4 (June 1965)

Bainer, Roy. "Some Thoughts Regarding Agricultural Mechanization in the United States." The Harvester (Journal Indian Institute of Technology. Kharagpur, India) Vol. VIII (1966)

Bainer, Roy. "The Evolution of Rice Mechanization in the United States." Proceedings of the International Rice Year (Mechanization and the World's Rice) Basil Blackwell Publishers, Oxford. pp. 150-154 (September 1966)

Bainer, Roy. "Rice Mechanization in the United States." Rice Journal 69(13):15-20 (December 1966)

Bainer, Roy. "The Interrelationship of Research and Education." Agricultural Engineering 48(3):141, 156 (March 1967)

Bainer, Roy. "Pioneering Research in Mechanization." Presented at American Association for the Advancement of Science Annual Meeting, Symposium on Pioneering in Research (December 1968)

Bainer, Roy. "Potentialities of the Systems Approach to Solutions of Agricultural Problems." Presented at Agricultural Extension Service Conference (1969)

Bainer, Roy. "Mechanization in Agriculture." Horticultural Science 4(3):321-232 (Autumn 1969)

Bainer, Roy. "Science and Technology in Western Agriculture." Agricultural History 49(1):56-83 (January 1975)

Bainer, Roy. "The Effect of Energy Availability on Future Agricultural Production." Symposium III, Energy in Agriculture, Kansas State University (March 1975)

INDEX

Avrom I. Dickman was born in Buffalo, New York in 1910. He received a B.A. degree from Penn State in 1932. He was in sales management for Equitable Life Assurance Society from 1932 to 1970 when he retired. Shortly thereafter, he became a volunteer editor in the Oral History Center at the University of California, Davis. He is past president of the Friends of the Library, University of California, San Diego and of Library Associates, University of California, Davis. He lives in Davis, California.

[illegible] [illegible] Parkman was born in Buffalo, New York in 1910. He received a B.A. degree from Penn State in 1932. He was in sales management for Equitable Life Assurance Society from 1932 to 1975 when he retired. Shortly thereafter, he became a volunteer editor in the Oral History Center at the University of California, Davis. He is past president of the Friends of the Library, University of California, San Diego and of Library Associates, University of California, Davis. He lives in Davis, California.